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Trade Liberalization, Employment Flows and Wage Inequality in Brazil[1]

Francisco H.G. Ferreira, Phillippe G. Leite and Matthew Wai-Poi[2]

Abstract: Using nationally representative, economy-wide data, this paper investigates the relative importance of trade-mandated effects on industry wage premia; industry and economy-wide skill premia; and employment flows in accounting for changes in the wage distribution in Brazil during the 1988-1995 trade liberalization. Unlike in other Latin American countries, trade liberalization appears to have made a significant contribution towards a reduction in wage inequality. These effects have *not* occurred through changes in industry-specific (wage or skill) premia. Instead, they appear to have been channeled through substantial employment flows across sectors and formality categories. Changes in the economy-wide skill premium are also important.

Keywords: Trade liberalization and inequality; employment flows; Brazil.

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[2] Ferreira and Leite are at the World Bank's Research Department. Wai-Poi is at Columbia University. We are grateful to Nina Pavcnik and Norbert Schady for kindly sharing their constructed industry concordance with us; and to Gustavo Gonzaga, Will Martin, Nina Pavcnik, Guido Porto, Martin Ravallion and Erik Thorbecke for helpful conversations or comments.

1. Introduction

The hypothetical link between "globalization" and inequality (within developed countries; within developing countries; or between them) has been the subject of a vast literature over the last 20 years. Even a cursory review of this literature reveals that "globalization" has been a "catch-all term that is used to describe phenomena as diverse as trade liberalization, outsourcing, increased immigration flows, removal of capital controls, cultural globalization and generally faster transmission of international shocks and trends" (Goldberg and Pavcnik, 2004, p.1). In this paper, we will focus on evidence pertaining directly to trade liberalization although, in some cases, it is difficult to separate the impacts of trade liberalization strictly defined from those of outsourcing, or of increased flows of technical and managerial knowledge.

Most of the literature on trade liberalization in Latin America has focused on Mexico, Chile and Colombia, and suggests that it has contributed to an *increase* in inequality (or at least in the gap between skilled and unskilled wages). Since there was a presumption that Latin America, like most other developing regions, was abundant in unskilled labor, this empirical finding appeared to contradict the predictions of the (two countries, two goods, two factors version of the) Stolper-Samuelson theorem in Hecksher-Ohlin trade theory. Although the next section briefly reviews some of this literature, this paper focuses on Brazil, a country where trade liberalization appears to have been *inequality-reducing*.

Previously one of the most heavily protected economies in the world, Brazil experienced an episode of marked trade liberalization between 1988 and 1995. Average nominal tariffs (weighted by lagged industry imports) fell from 43.4% in 1987 to 13.9% in 1995. Effective rates of protection fell from 55.8% to 20.0% in the same period. These large changes in protection had a correspondingly large impact on trade flows: import/consumption ratios across all manufacturing sectors rose from 15% in 1986 to 31% in 1998. Figure 1 shows the evolution of both tariff rates and trade flows over the

1985-1999 period. [3] It has also been argued that this episode of trade liberalization had a substantial impact on labor and total factor productivity growth, with the latter increasing by 6 percentage points in annual rate terms (Ferreira and Rossi, 2003).

During this period Brazilian inequality, which had been rising until 1989, started a gradual but persistent decline. Figure 2 shows the long-term evolution of two commonly-used inequality measures, the Gini and the Theil indices, between 1981-2004, for household income per capita. The bands around the point estimates denote the 95% bootstrapped confidence intervals. The Figure highlights the trade-liberalization period of 1988-1995, during which inequality briefly rose (for one year) and then began to fall. The Theil index fell from 0.75 to 0.71 and the Gini fell by almost two points from 0.61 to 0.59 over this seven-year interval. Both declines are statistically significant at the 1% level. As shown in Figure 3, inequality also fell in the distribution of hourly wages: the Gini fell by almost three points, from 0.61 to 0.58 and the Theil fell from 0.78 to 0.72. Both declines are significant at the 5% level. The economy-wide skill-premium (defined as the ratio of the wages of skilled workers to those of unskilled workers) fell by 14.3% (see Figure 4).[4] Looking only at the skill premium in manufacturing, Gonzaga et al. (2006) find a similar (15.5%) decline between 1988 and 1995.

Were these two phenomena linked? Did trade liberalization (and other aspects of increased openness which took place alongside it) cause at least part of the contemporaneous decline in Brazilian inequality? The literature is somewhat inconclusive. Focusing on the specific channels of industry wage premia (and industry-specific skill premia) Pavcnik et al. (2004) find no evidence of any effect from trade liberalization on the Brazilian wage distribution. More recently, Gonzaga et al. (2006) argue persuasively that, through the more general channel of changes in the economy-wide skill premium (as opposed to industry-specific premia), trade liberalization did

[3] The data reported in Table 1 weigh tariff rates by lagged industry imports. An alternative weighting scheme (by industry value-added) generates an even more pronounced decline: citing data from Kume et al. (2000), Abreu (2004) reports a decline in nominal tariffs from 54.9% in 1987 to 10.8% in 1995. Effective rates of protection fell from 67.8% to 10.4% in the same period.

[4] We use an education-based definition of skill: skilled workers have 11 or more years of schooling; and unskilled workers are those with ten or fewer. We return to a discussion of this definition and alternatives below.

reduce wage disparities in Brazil. Although these two studies cover the same period, they use different data sets and methodologies, which lead them to focus on different aspects of the same phenomenon.

Despite their differences, both studies focus on workers in manufacturing only. The manufacturing sector accounted for 16% (13%) of total employment in 1988 (1995) and there can be no *a priori* presumption that changes in the skill premium in that sector drive national wage inequality. During this same period, there has also been a convergence between urban and rural incomes in Brazil, which is often attributed to agricultural growth.[5] Although agriculture is eminently tradable, it has not to our knowledge been included in any analysis of liberalization and distribution in Brazil.

This paper seeks to revisit the evidence on Brazil's trade liberalization in a more comprehensive way. We innovate in four ways. First, we combine the approach used by Pavcnik et al. (2004) to study trade-mandated changes in industry-specific wage and skill premia, with a consideration of the economy-wide skill premium on which Gonzaga et al. (2006) focus, and ask what was the combined effect of the two channels on the wage distribution in Brazil. Second, unlike previous studies, our analysis covers workers in all sectors of the economy, including agriculture and services. Third, we explicitly consider employment responses to the tariff and exchange rate changes that took place over the period, investigating a channel of impact which is generally acknowledged as potentially important in theory, but seldom studied in practice. Fourth, we use our estimated models of wages and employment levels to simulate counterfactual wage distributions which allow us to decompose the changes in distribution actually observed over the seven years of trade liberalization into various components – some directly attributable to trade reforms, some which may or may not reflect trade changes, and some which are most likely independent of trade factors.

Our main findings are, first, that trade liberalization in Brazil did in fact contribute to the observed reduction in wage inequality in the entire Brazilian economy – and not just in

[5] See Ferreira, Leite and Litchfield (2006).

manufacturing. As argued by Gonzaga et al. (2006) - and unlike in Chile, Mexico and Colombia – Brazil's pre-liberalization tariffs (adjusted by import penetration) were highest for skill-intensive goods. These tariffs fell by more than those for other goods, leading to a decline in their relative prices. Consistent with the simple Stolper-Samuelson theorem, this decline led to a decline in skilled wages, relative to those of unskilled workers, and to a movement of workers away from previously protected industries. As Pavcnik et al. (2004) found, other channels of impact through industry-specific wage and skill premia were unimportant.

Second, the decomposition results suggest that: (i) changes in industry-specific wage premia and skill premia were unimportant. Although changes in tariffs have the expected sign, the overall effect on the wage distribution was negligible. (ii) The bulk of the trade impact on the wage distribution occurs through the employment and occupational reallocation that took place in response to changes in tariffs and relative prices. This effect accounts for a substantial fraction of the observed reduction in inequality between 1988 and 1995. (iii) Changes in the economy-wide returns to skill – which may be at least partly driven by trade reforms – contributed to a further reduction in inequality (as did changes in other returns). (iv) Changes in the joint distribution of (observed and unobserved) worker characteristics were inequality-increasing, and partly offset some of the trade-driven changes in inequality.

The paper is organized as follows. The next section provides a very brief overview of the literature, focusing on the conceptual channels through which trade reforms affect the distribution of incomes, and on five or six specific theoretical mechanisms through which openness has been hypothesized to affect wages and employment. Section 3 describes our data sets and the methodological approach. Section 4 presents the estimation results for a set of wage and employment regressions. Section 5 discusses a decomposition of the changes in Brazil's wage distribution between 1988 and 1995, drawing on counterfactual distributions constructed on the basis of the models estimated in Section 4. It also discusses the implications of the wage decomposition for poverty and inequality more broadly, measured in the distribution of household per capita incomes. Section 6 concludes.

2. A Brief Literature Review

The literature on the relationship between "globalization" and distribution is now so extensive that Goldberg and Pavcnik (2004) open their recent survey of the subject by noting that "the number of literature reviews alone is so large by now, that it seems that a review of literature reviews would be appropriate" (p.1). Given the existence of two excellent recent surveys – Winters, McCulloch and McKay (2004) and Goldberg and Pavcnik (2004) – we make no attempt at an exhaustive review here. Instead, this section briefly reviews two sub-themes which are of particular importance for our analysis in this paper: the channels through which trade reforms affect the distribution of income (and hence inequality and poverty); and the recent evidence on the distributional effects of trade reform in Latin America in general, and in Brazil in particular.[6]

2.1. Channels of Impact from Trade Liberalization to Household Incomes

If openness to the international economy brings persistent gains in terms of access to new knowledge and technology; or sustained gains in the growth rate of total factor productivity, then it is possible that trade liberalization leads to faster long-run economic growth. Whether or not this is in fact the case has been the subject of a debate, with Sachs and Warner (1995) and Edwards (1998) among the proponents, and Rodriguez and Rodrik (2001) leading the skeptics. The current balance of opinion seems to be that "despite the econometric and conceptual difficulties of establishing beyond doubt that openness enhances income levels, the weight of experience and evidence seems strongly in that direction" (Winters et al., 2004, p.78).

[6] See also Nissanke and Thorbecke (2006) for a thoughtful discussion of the links between globalization and distribution.

If this is indeed the case, the effect of trade on growth, whether it is mediated through a faster rate of technology adoption or through greater dynamic efficiency gains from competitive pressures, is likely to be of first order importance in any understanding of the relationship between "globalization" and poverty, and policy makers should bear it very much in mind. Nevertheless, this paper belongs to the (large) strand of literature that seeks to understand the static or short-term impacts of trade liberalization on the distribution of incomes. When tariffs (or non-tariff barriers) are reduced or eliminated, the domestic prices of the relevant goods change. These price changes can affect household incomes (or consumption) through five main direct channels, namely:

- *Output and input prices.* If household members are self-employed, producing, trading and consuming different goods, then the first-order approximation to the change in their welfare as a result of changes in the price vector is simply $\Delta W = \sum_i (q_i - c_i)\Delta p_i$.[7] The basic insight is that net producers of those goods whose prices fall as a result of trade reforms lose out, while net consumers gain.
- *Wages.* For household members who are employed, the first effect of price changes is through the knock-on effect on factor prices, and crucially on the individual's wage. The exact transmission mechanisms depend on the degree of competition in both factor and product markets, but the benchmark result under competitive markets is that as protection declines and relative goods prices move against the previously protected good, relative factor prices also move against the factor in which the protected good is intensive. This is the well-known Stolper-Samuelson theorem in Hecksher-Öhlin trade theory.[8]
- *Employment.* In response to changes in profitability that arise because of the aforementioned changes in product and factor prices, the composition of production typically changes after trade reforms. Industries whose product prices have fallen contract, and those whose relative product prices have risen expand. In

[7] See Deaton (1997), and discussion in Winters et al. (2004).

[8] The theorem generates less clear-cut results in a world with more than two countries, goods or factors of production but, as we shall see, the basic insight from the 2x2x2 version of the theorem remains remarkably powerful.

response, there is a reallocation of employment across sectors and, in imperfect labor markets, changes in unemployment and/or the size of the informal sector.

- *Consumption Prices.* Self-employed workers are not the only people who consume. Employed workers, who are affected on the income side through changes in their wages and employment sector, are also affected by the changes in the relative prices of the goods they consume. Trade models often pay little heed to this channel because, if preferences are identical across individuals and homothetic, then changes in relative prices will affect all households equi-proportionately. But if preferences are not, in fact, homothetic, or if they differ across households, then the *shares* of different goods in their consumption bundles will vary, and relative price changes will affect different households differently. Under this channel, we also include changes in the *quality* of consumption goods available to consumers, either directly because of differences in quality between imported and domestically-produced goods, or because of improvements in domestic production as a result of import competition, or of the availability of imported inputs.
- *Taxes and Public Expenditures.* As tariffs change so, in general, will tariff revenues. Although there is much evidence that it is possible to reduce protection in a revenue-neutral – or even revenue-enhancing – manner, if revenues do fall, then there will either be a decline in the level of some public service or transfer, or a rise in some other tax.[9] The incidence of these changes is entirely dependent on which expenditures or taxes are altered, and on their (marginal) incidence.

Ultimately, all trade reforms must affect household welfare – and its distribution – through one of these five primary channels. Much of the discussion in the literature has focused, however, on the nature of the mechanism through which tariff changes affect wages and employment levels. A trade reform that lowers tariffs for a number of goods may affect relative wages and the composition of employment through the standard

[9] The evidence suggests, however, that it has in many cases been possible to liberalize trade without loss in revenues. This may occur because non-tariff barriers generate rents for private agents, rather than government revenue; because some tariffs may initially be above their revenue-maximizing level; or because some trade reforms occur concomitantly with enhancements in the efficiency of customs agencies. See Ebrill et al. (1999) and the discussion in Winters et al. (2004).

Stolper-Samuelson channel, as described above, but it may also work in a number of different ways. These have been reviewed in some detail by Goldberg and Pavcnik (2004), and we provide only a sketch below:

- There may be changes in the wage premia to *specific occupations* (as opposed to industries), such as managers and highly skilled professionals. (See Cragg and Epelbaum, 1996).
- Trade liberalization may be accompanied by adjustments not only in the national composition of production, but in the *international* composition, with some activities being outsourced from developed to developing country locations. One hypothesis is that some of these activities are intensive in workers that are unskilled by rich-country criteria, but skilled in developing countries. See, for instance, Feenstra and Hanson (1996).
- Technical change that raises firms' relative demand for skill is known as *skill-biased technical change* (SBTC). Whereas in developed countries SBTC is typically seen as a competing explanation (vis-à-vis trade openness) for increases in skill premia, it has recently been argued that in developing countries, SBTC may be spurred on by trade liberalization. See Acemoglu (2003) and Theonig and Verdier (2003) for different models of how trade liberalization might lead to skill-biased technical change in developing countries. If indeed trade liberalization leads to changes in the relative demand for skilled and unskilled workers because of induced changes in technology, then this is a separate effect, additional to Stolper-Samuelson.
- Related to the previous two channels is the possibility that greater openness changes the *quality composition of domestic output*. Most goods (shoes, textiles, cars or computers) can be produced with very different quality, and there is some evidence that greater participation in world trade shifts production towards higher-quality goods in (at least some) domestic firms. This may be in response to greater import competition, or because exchange rate changes shifts resources from non-exporters to exporters. If higher-quality varieties are more intensive in skilled workers, this effect too could raise the relative demand for skills in the

labor force. See Verhoogen (2006) and Shigeoka, Verhoogen and Wai-Poi (2006) for evidence from Mexico.

- Finally, wage levels for observably identical workers are not the same across different industries, either because of imperfect competition that gives rise to industry rents; or because of compensating differentials; or industry-specific skills. It is possible that tariff and mandated price changes affect these differentials, in addition to any impact they may have on the economy-wide skill premium. See e.g. Goldberg and Pavcnik (2005) on Colombia.

2.2. The Distributive Impact of Trade Liberalization in Latin America

Contrary to what was found in earlier LDC liberalization episodes, notably in East Asia, Latin American trade liberalizations during the 1980s and 1990s have been predominantly contemporaneous with *increases* in the economy-wide wage skill premium, which is typically defined as the ratio of wages of skilled workers to the wages of unskilled workers.[10] Although this ratio is not a particularly good measure of wage inequality, and certainly a very poor indicator of inequality in household incomes, it has been the focus of most empirical work.[11]

Evidence of a rising skills gap has been comprehensively established for Mexico, by Feenstra and Hanson (1995), Cragg and Epelbaum (1996), Feliciano (2001), and Hanson and Harrison (1999), among others. It has also been documented for Chile by Beyer, Rojas and Vergara (1999); for Colombia by Attanasio, Goldberg and Pavcnik (2004); and for Costa Rica by Robbins and Grindling (1999). Given the presumption that developing countries are abundant in unskilled labor, the first reaction to these results was that it seemed to contradict the Stolper-Samuelson Theorem, and considerable effort has been expended in proposing alternative explanations, many of which were described in general terms in the preceding subsection.

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[10] It matters whether skill levels are measured in practice by education levels (as typically done in studies based on household survey data) or by production vs. non-production workers (as commonly done in studies using firm-level data.

[11] Later in this paper, we investigate how changes in skill premium map into changes in more general measures of inequality.

Adrian Wood (1997) argued that the simplest version of Stolper-Samuelson may not apply, because Latin American countries are perhaps abundant in land and natural resources, rather than unskilled labor; or because of the entry into the international trading system of countries even more unskilled-labor abundant, such as China and India. As discussed, Feenstra and Hanson (1995) suggested that part of the increase in the demand for skill in Mexico was due to outsourcing. Cragg and Epelbaum (1996) argued that it was driven by the increases in the returns to specific occupations, such as managers and administrators, who were highly skilled (rather than by returns to all skilled workers in the economy). Others have argued that greater openness has spurred a process of technological change that is skill-biased, as also discussed above. Attanasio, Goldberg and Pavcnik (2004) interpret their finding that increases in demand for skilled workers were largest for sectors with the largest tariff cuts as supporting the thesis of an endogenous skill-biased change in technology, that occurs in response to competitive pressures and to the availability of inputs brought about by greater openness.

Each of these alternative stories – occupational rewards; skill-biased technical change; quality upgrading; outsourcing – is plausible, and each is supported by at least some of the available evidence. But it is also true that an examination of the patterns of protection in Chile, Colombia and Mexico prior to liberalization reveals that tariffs were generally higher for industries intensive in unskilled labor (than for skill-intensive industries). In this case, a fall in the relative prices of these goods, and thus in the price of the factor they are intensive in, is perfectly in line with the Stolper-Samuelson theorem in the first place.[12]

Brazil was an exception, in that effective protection prior to liberalization was higher for skill-intensive industries. The correlation between tariffs and industry skill-shares in 1988 was mildly positive, and much stronger once tariffs are adjusted by the industry import penetration rates, which account for differences in the pass-through between tariffs and

[12] See Goldberg and Pavcnik (2004) for discussion.

prices in different sectors.[13] Gonzaga et al. (2006) show that, as tariffs were (partly) harmonized between 1988 and 1995, the tariff and effective rates of protection (ERPs) declines for skill-intensive industries were greater than for industries intensive in unskilled workers. In accordance with Stolper-Samuelson predictions, the relative prices of skill-intensive goods then fell, as did the relative wages of more skilled workers. Using mandated wage equations, these authors estimate that the decline in the manufacturing skill premium over this period was of the order of 25% - larger than the actually observed 15% decline.

In addition, the pattern of labor reallocation was more consistent with a Stolper-Samuelson effect of trade liberalization, than with a Rybczynski-style effect of increases in the endowment of skilled labor: the manufacturing employment share of skilled workers rose by 2.67%, which decomposed into a 3.34% within-industries effect, and a negative 0.67% percent between industry effect. This contraction in the employment share of skill-intensive industries would not be expected if the dynamics were driven primarily by expansion in the endowment of skilled workers in Brazil, but is consistent with the expected employment reallocation in response to a trade shock.

The evidence presented by Gonzaga et al. (2006) strongly suggests that the Brazilian trade liberalization of 1988-1995 played some role in the decline of inequality in Brazil which began during that period. It appears to have done so through the classic channel of changes in the economy-wide skill premium, in line with the prediction of Hecksher-Ohlin trade theory, leading to a sizable decline in the wage gap between skilled and unskilled workers in manufacturing.[14]

But how important was this change in the skill premium for the actual size distribution of hourly wages in Brazil? There are two reasons why its importance is far from guaranteed: one is that skilled and unskilled workers are large and heterogeneous groupings. There is

[13] See Gonzaga et al. (2006) on the importance of this correction.

[14] The literature suggests that alternative channels of impact were less important. Pavcnik et al. (2004), for instance, find no evidence that changes in industry-specific wage premia (or in skill-premia specific to certain industries) changed in response to trade liberalization.

considerable wage variation within each group, and the two group distributions do overlap. The second reason is that Gonzaga et al. (2006) consider only manufacturing workers, which accounted for 16% (13%) of total employment in 1988 (1995). Changes in their relative position vis-à-vis workers in agriculture (which were also affected by changes in tariffs) and in services (which were indirectly affected by changes in tariffs, and also by changes in the exchange rate) may have led to overall changes in wage inequality which are quite different from those mandated by the Stolper-Samuelson effects within manufacturing.

In the remainder of this paper we examine two basic questions. First, we seek to place the changes in wage inequality which can be attributed to trade policy changes in the context of other changes that were concurrently affecting the wage distribution. Second, and more specifically, we also seek to quantify the contribution of the trade-mandated employment reallocation effects to changes in the wage distribution. A third, albeit more tentative, contribution is to investigate the implications of these trade-driven changes in the wage distribution for poverty and inequality in the distribution of household incomes per capita.

3. Data and Methodology.

3.1 The Data Sets.

The data used in this study come from two different sources. The first of these is the household survey data, which are used to obtain information on wages, hours of work, occupations, education levels, age, gender, race and location of workers. We use 11 waves of the *Pesquisa Nacional por Amostra de Domicílios* (PNAD), fielded by the *Instituto Brasileiro de Geografia e Estatística* (IBGE), annually between 1987 and 1999.[15] The PNAD is a nationally representative household survey, with a stratified and clustered sampling design which ensures coverage of rural and urban areas in every state of the federation, except for the rural areas of Acre, Amapá, Amazonas, Pará, Rondônia

[15] There are eleven waves because the survey was not carried out in 1991 or 1994.

and Roraima.[16] Sample sizes varied somewhat from year to year, around approximately 300,000 individuals per year.

For our wage analysis, we considered all workers aged 15-65 who reported positive earnings during the survey's reference week. Since we are interested in quantifying the importance of trade and openness-related changes in explaining overall changes in the wage distribution, we include all workers, in agriculture, industry and services, regardless of formality or own-account status. Effective sample sizes for this analysis were 107,195 workers in 1998 and 123,455 workers in 1995. This is an important difference between our analysis and those of Gonzaga et al. (2006), or Pavcnik et al. (2004), who focus exclusively on workers in manufacturing.[17] The wage definition is hourly wages, calculated as a quarter of the monthly wage, divided by the number of hours worked on the average week. All monetary values are inflated to September 2004 prices, using the INPC deflator with the Corseuil and Fogel (2002) adjustment to the 1994 index. See Ferreira, Leite and Litchfield (2006) for the full deflator in each PNAD reference month.

As all PNAD-based studies, we use years of schooling as our measure of a worker's skill.[18] In earnings regressions, we group workers into nine schooling groups: zero years; 1-3 years; 4 years; 5-7 years; 8 years (completed primary); 9-10 years (some high school); 11 years (completed high school); 12-14 years (some university); 15+ years (completed university). We also use this variable to construct a dichotomous skill indicator, classifying workers with 0-10 years of schooling as unskilled, and those with 11 or more (completed high school and above) as skilled. Earnings regressions were also estimated with an alternative indicator, which classified only workers with 15 years of

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[16] These rural areas broadly correspond to the Amazon rainforest, which was excluded from PNAD sampling until 2003. Census data suggests that these areas account for 2.3% of the Brazilian population.

[17] The sample in Pavcnik et al. (2004) is, in addition, based on the Pesquisa Mensal de Emprego (PME) and is thus only representative of the country's six main metropolitan areas.

[18] Use of education to define a worker's skill is in fact common to most household or labor-force survey-based studies. Articles relying on firm-level data typically classify production workers as unskilled, and non-production workers as skilled. Although Slaughter (2000) shows that the two definitions do not seem to lead to very different conclusions in the US, Gonzaga et al. (2006) show that the distinction does matter for Brazil. Like the latter authors, we feel that the education classification is more appropriate in the Brazilian case, since trade liberalization and outsourcing of support activities led to considerable changes in the employment levels of non-productions workers during the period.

schooling or more as skilled, and all results were qualitatively robust. Since workers with completed university accounted for 4.5% of the labor force in 1988; while workers with complete high school and above represented 16.4%, we chose the latter classification as more meaningful for Brazil. See Gonzaga et al. (2006) for a similar discussion of this classification.

The second data set used for this study comprises the trade-related variables for 22 industries, across the 1987-1999 period. Six trade-related variables are used: nominal tariffs and effective rates of protection come from Kume et al. (2000), as reported in Abreu (2004); import penetration and export shares by industry come from Muendler (2003); and import-weighted and export-weighted industry-specific exchange rates were constructed by the authors, based on the methodology suggested by Goldberg (2004), and using data from the World Bank's World Development Indicators and the UN's COMTRADE.[19] Table 1 presents initial (1988) and terminal (1995) values for each of these variables for the 22 industries into which we have grouped Brazilian firms.[20] As in Pavcnik et al. (2004), our use of household survey and trade data with different industry definitions necessitated a concordance between the various datasets, mapping the more disaggregated industry classifications in the trade data to the broader PNAD classifications. In addition to the standard *Nível 80* to *Nível 100* concordance,[21] we developed concordances of our own. The main one is based on (but not identical to) Pavcnik et al. (2004), and is presented in Table 2.[22] A more detailed description of the steps taken to clean, construct and match the data is included in the data appendix.

[19] As Goldberg (2004) notes, "At the national level, analyses of exchange rate moves often rely on aggregate trade-weighted exchange rates. However, aggregate indexes can be less effective than industry-specific indexes in capturing changes in industry competitive conditions induced by moves in specific bilateral exchange rates." (p.1)

[20] Although we use data until 1999 in our estimation stage, the key initial and terminal years for our wage decomposition analysis are 1988 (at the onset of trade liberalization) and 1995 (the year in which it was completed.

[21] Available on Marc Muendler's excellent website of Brazilian data resources (http://www.econ.ucsd.edu/muendler/html/brazil.html). Nível 80 and 100 are official Brazilian industry classifications.

[22] We are grateful to Nina Pavcnik and Norbert Schady for graciously making the details of their concordance available to us. A further concordance between Nível 100 and the trade categories used by Kume et al (2000) was also constructed, but is too detailed to present here.

3.2. Methodology.

Since the objective is to understand and quantify the role of trade-induced changes in the wage distribution, in relation to the overall observed changes, we combine an extended version of the two-stage estimation framework which has recently been used to investigate the effect of trade reforms on wage premia in a number of settings, with a more general decomposition of changes in the entire wage distribution. Following Pavcnik et al. (2004), our first stage regresses log hourly wages (w_{ij}) on a vector of worker i's characteristics (including sex, race, experience, education, residential region, urban/rural status, household headship status, and formality status); a vector of industry j indicators (I_{ij}); and a set of interactions between industry indicators and skill category:[23]

$$\ln w_{ij} = X_{ij}\beta + I_{ij} * wp_j + (I_{ij} * S_{ij})sp_j + \varepsilon_{ij} \tag{1}$$

Equation 1 is estimated separately for each year in the data set, from 1987 to 1999. In addition to the wage equation, our first stage also includes a model of employment for each year in the sample, where an individual's occupation is regressed on a similar set (Z_{ij}) of personal characteristics, as well as whether or not he or she has children, and the spouse's occupational status. Given the polychotomous nature of the occupational choice, this relationship is estimated with a multinomial logit model:

$$\Pr\{j = s\} = P^s(Z_i, \lambda) = \frac{e^{Z_i \lambda_s}}{e^{Z_i \lambda_s} + \sum_{j \neq s} e^{Z_i \lambda_j}} \tag{2}$$

In equation (2), there are ten possible occupational choices (j), corresponding to inactivity; unemployment; self-employment; employer status; and formal or informal employment in each of three broad sectors: agriculture, manufacturing and services. The full specification of models (1) and (2) is presented in the next section, alongside with results.

[23] Recall, skilled workers are defined here as having completed high school or better (11+ years of education).

In the second stage, three sets of estimated coefficients from the first stage are pooled over time and regressed on a set of trade-related industry characteristics. The dependent variables in this stage are: (i) the industry premia coefficients from (1), wp_{jt}; (ii) the industry-specific skill premia coefficients from (1), sp_{jt}; and (iii) the constant terms λ_{0jt} for each occupation from (2). Each of these variables $v_{jt} = \{wp_{jt}; sp_{jt}; \lambda_{0jt})$ is regressed (in first differences) on a set of trade-related variables (T_{jt}), including industry- specific effective rates of protection, import- and export-weighted exchange rates; import penetration and export shares:

$$\Delta v_{jt} = \Delta T_{jt}\gamma + \eta_{jt} \tag{3}$$

In addition to estimating a two-stage employment model, which we have not seen in the trade literature, there are other differences between these estimations and those reported in Pavcnik et al. (2004). Our data comes from a nationally representative household survey (the PNAD), and include workers in agriculture and non-tradable industries (for which industry-specific exchange rates can be constructed,[24] and affect relative prices). Rather than relying on the manufacturing sector in the six largest metropolitan areas of Brazil, our sample is therefore much more broadly representative of the country. Possibly as a result, some of our estimation results are different than those in Pavcnik et al. (2004), and we discuss them briefly in the next section.

But the main purpose of estimating equations (1)-(3) is to use them in the decomposition of all changes in the full wage distribution between 1988 and 1995. Following Juhn, Murphy and Pierce (1993) – henceforth cited as JMP – one can decompose the difference between the wage distribution prior to the liberalization (say, in 1988) and the wage distribution afterwards (say, in 1995) into three components: one due to changes in observed worker characteristics (X); one due to changes in the returns to those characteristics (measured by regression coefficients β) and a final one due to changes in

[24] We use economy-wide import- and export-weighted exchange rates for the non-tradables sector.

the distribution of residuals (ε). Writing the distribution function of the residuals of equation (1) as $\theta_{it} = F_t(\varepsilon_{it})$, a standard JMP decomposition would proceed as follows.[25]

After estimating earnings regressions (like (1)) in both initial and terminal years:

$\ln w_{i88} = X_{i88}\beta_{88} + F_{88}^{-1}(\theta_{i88})$ and

$\ln w_{i95} = X_{i95}\beta_{95} + F_{95}^{-1}(\theta_{i95})$,

one would simulate two counterfactual wage distributions, as follows:

$$\ln w_i^a = X_{i88}\beta_{95} + F_{88}^{-1}(\theta_{i88}) \tag{4}$$

$$\ln w_i^b = X_{i88}\beta_{95} + F_{95}^{-1}(\theta_{i88}) \tag{5}$$

The difference between wage distributions $G(w_{88})$ and $G(w^a)$ would be interpreted as being due to differences in returns between the 1988 and 1995. The difference between $G(w^a)$ and $G(w^b)$ would be due to changes in the distribution of (or returns to) unobservable worker characteristics. Finally, the difference between $G(w_{95})$ and $G(w^b)$ would be due to changes in the joint distribution of observed worker characteristics (and their joint correlation with the residuals).[26]

Using our estimates of equations (1) – (3), we construct an expanded set of such counterfactual wage distributions, which also form an exact decomposition of the observed change between 1988 and 1995.[27] We construct six counterfactual wage distributions, chosen to shed light on different channels of effect from the trade-liberalization. Not all of the channels discussed in Section 2 are covered, but the key wage and employment channels are addressed.

[25] We say "**a** standard JMP decomposition" because there are variations on the basic theme. Alternative orderings could be used, or average coefficients instead of final year coefficients, etc. The specific interpretation varies, but the essence of the insight is the same.

[26] As noted by JMP, and in the closely related work of DiNardo et al. (1996) and Bourguignon Ferreira and Lustig (2004), this is an accounting decomposition. Changes in the return structure are clearly causally related to changes in the distribution of characteristics (in more than one way). The decomposition exercise does not disentangle these causal relations, but provides a description of the observed changes.

[27] As in the original JMP decomposition, and indeed in any generalized Oaxaca-Blinder decomposition, the order of the simulations matter: the decomposition is path dependent. See Lemieux (2002) and Bourguignon et al. (2004) for discussions.

Departing from equation (1), our first counterfactual is:

$$\ln w_{ij}^{1} = X_{ij}^{88}\beta^{88} + I_{ij}^{88} * wp_{j}^{s} + (I_{ij}^{88} * S_{ij}^{88})sp_{j}^{88} + F_{88}^{-1}\left(\theta_{i88}\right) \tag{6}$$

where $wp_{j}^{s} = \left(T_{j}^{95} - T_{j}^{88}\right)\hat{\gamma}_{wp}$ and $\hat{\gamma}_{wp}$ are the estimated coefficients in the second-stage regression (3) for the industry wage premia. This first simulation therefore corresponds to changes in the wage distribution due only to those changes in industry wage premia which are mandated by changes in the exogenous trade variables included in the second-stage equation (3). The second counterfactual is:

$$\ln w_{ij}^{2} = X_{ij}^{88}\beta^{88} + I_{ij}^{88} * wp_{j}^{s} + (I_{ij}^{88} * S_{ij}^{88})sp_{j}^{s} + F_{88}^{-1}\left(\theta_{i88}\right) \tag{7}$$

where $sp_{j}^{s} = \left(T_{j}^{95} - T_{j}^{88}\right)\hat{\gamma}_{sp}$ and $\hat{\gamma}_{sp}$ are the estimated coefficients in the second-stage regression (3) for industry-specific skill premia. The third counterfactual is

$$\ln w_{ij}^{3} = X_{ij}^{88}\beta^{88} + I_{ij}^{s} * wp_{j}^{s} + (I_{ij}^{s} * S_{ij}^{88})sp_{j}^{s} + F_{88}^{-1}\left(\theta_{i88}\right) \tag{8}$$

where I_{ij}^{s} is a counterfactual vector of occupations, constructed by substituting $\lambda_{0j}^{s} = \left(T_{j}^{95} - T_{j}^{88}\right)\hat{\gamma}_{\lambda_0}$ into the occupational multinomial logit in equation (2), and then using it to predict the corresponding counterfactual distribution of occupations.[28] This third simulation therefore corresponds to the overall effect of industry premia, industry-specific skill premia and employment changes mandated by the second-stage trade variables, under the maintained functional form assumptions in (3).

The power of the preceding counterfactuals to simulate the changes in the wage distribution that arise from trade reforms depends entirely on the ability of the linear second stage equations to identify the impact of changes in tariffs and exchange rates on wage premia and employment probabilities. They also miss, so far, a key theoretical channel through which a trade liberalization is likely to impact on wage differences in the

[28] As noted above, the ten occupational categories specified in equation 2 were more aggregated than the 22 industries for which wage and skill premia are estimated. In constructing *G*(w^3), workers whose predicted occupations differed from those observed in 1988 due to changes in λ_{0j} were allocated to specific industries (within the broad sector to which they were mapped by the multinomial logit) by random draws with probabilities derived from the 1995 employment distribution across industries.

economy, namely changes the *economy-wide* skill premium. After all, the wp_j and sp_j coefficients capture only changes in industry specific remuneration rates, controlling for changes in the average returns to education. Our fourth counterfactual is therefore:

$$\ln w_{ij}^{4} = X_{ij}^{88}\beta^{s} + I_{ij}^{s} * wp_{j}^{95} + (I_{ij}^{s} * S_{ij}^{88})sp_{j}^{95} + F_{88}^{-1}(\theta_{i88}) \tag{9}$$

where $\beta^{s} = \{\beta_{ed}^{95}; \beta_{-ed}^{88}\}$. The difference between (9) and (8) is twofold: the industry and industry-specific skill premium coefficients mandated by the second stage are replaced with those estimated in 1995; and the economy-wide returns on schooling coefficient is replaced with its 1995 value. This simulation therefore corresponds to a "more generous" estimate of the "price effects" of trade liberalization, in which the full changes in returns to education and to industry membership – rather than only those mandated by the second stage – are included. Although the main channel through which trade reforms might affect β_{ed}^{95} is the Stolper-Samuelson effect of reduced protection in skill-intensive industries, there may be other channels too. If one is prepared to accept that skill-biased technical change in Brazil, or skill-demanding changes in the quality composition of domestic output, are endogenous to trade liberalization, as discussed in Section 2, then one may come closer to the view that all changes in the returns to schooling between 1988 and 1995 are, in some way or another, related to trade. Be that as it may, we see this particular counterfactual wage distribution as a generous estimate of the joint wage and employment effects of trade on the wage distribution. The true contribution of trade liberalization to changes in Brazilian inequality is likely to lie somewhere between the changes accumulated up to equation (8) and those corresponding to (9).

Three remaining steps (and two counterfactual distributions) complete the decomposition – and represent changes that are less likely to have been driven by trade reforms. The first of these (in equation 10) computes the additional changes in the structure of returns to observed characteristics (like experience, location, race, gender, etc.). The second (in equation 11), brings in the distribution of residuals from 1995, in a rank-preserving transformation:

$$\ln w_{ij}^{5} = X_{ij}^{88}\beta^{95} + I_{ij}^{s} * wp_{j}^{95} + (I_{ij}^{s} * S_{ij}^{88})sp_{j}^{95} + F_{88}^{-1}(\theta_{i88}) \qquad (10)$$

$$\ln w_{ij}^{6} = X_{ij}^{88}\beta^{95} + I_{ij}^{s} * wp_{j}^{95} + (I_{ij}^{s} * S_{ij}^{88})sp_{j}^{95} + F_{95}^{-1}(\theta_{i88}) \qquad (11)$$

Finally, the difference between (11) and the equation estimated for 1995:

$$\ln w_{ij}^{95} = X_{ij}^{95}\beta^{95} + I_{ij}^{95} * wp_{j}^{95} + (I_{ij}^{95} * S_{ij}^{95})sp_{j}^{95} + F_{95}^{-1}(\theta_{i95}) \qquad (12)$$

corresponds to differences in the joint distribution of observed characteristics between 1995 and 1988 (except for the changes in occupational structure due to trade, which had been predicted in equation 8). This step also accounts for changes in the correlation between the observed characteristics and the residual terms, including any changes in selection into the labor force.

Only equation (1), for 1988, and equation (12), for 1995 are estimated on observed data. Equations (6)-(11) give rise to simulated wage distributions $G(w^1)$ to $G(w^6)$. In Section 5, simulation results are presented in two ways. First, a number of inequality indicators are computed for each counterfactual distribution, so that we can decompose the observed changes between 1988 and 1995 into the components corresponding to each counterfactual. Second, we can see a fully disaggregated picture by plotting the observed wage growth incidence curve between 1988 and 1995, $g(p) = w_p^{95} - w_p^{88} / w_p^{88}$, and presenting each intermediate counterfactual growth incidence curve: $g^s(p) = w_p^s - w_p^{88} / w_p^{88}$, s = 1, …,6.[29]

4. Estimation Results

Before we turn to the simulation results in the next section, this section presents the estimation results on which they build. Table 3a presents the main first-stage results for the wage equation (1), while Tables 3b and 3c report the industry-specific wage and skill

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[29] The "wage growth incidence curve" is an application to the distribution of wages of Ravallion and Chen's (2003) concept of growth incidence curve, which those authors originally defined on the distribution of household incomes or expenditures.

premia coefficient estimates respectively. Each model was estimated for each year in the 1987-1999 interval for which data were available. The results in Table 3a are in line with existing analysis of the Brazilian labor market (see e.g. Ferreira and Barros, 1999). There are large and significant returns to education, and smaller and concave returns to experience. Measured with respect to zero years of schooling, returns to education fell consistently over the period. This decline was most pronounced for intermediate education categories (4-10 years of schooling). Returns to experience have also fallen. There is a substantial male wage premium, which has also been declining. In contrast, racial premia of both whites and Asians with respect to Afro-Brazilians have persisted or increased. Controlling for other observed characteristics, employers, the self-employed and formal employees all earn more than informally employed workers. Metropolitan and urban location premia vis-à-vis rural workers of identical characteristics have also fallen over the period, though they remain statistically significant. All specifications also include industry and interacted industry-skill indicators, the coefficients on which are reported in Tables 3b and 3c. These coefficients are then pooled and regressed on a vector of trade variables in the second stage.

Table 4a reports the first-stage results for the employment model in (2), as marginal effects of unit changes in each independent variable, with all other variables held at their mean values. These estimates are also mostly in line with expectations. Workers with more experience and education are less likely to be employed in agriculture or informally. In addition, those with higher education are also more likely to be employers, as are whites and Asians, and to work in the formal non-tradables sector, presumably often as professionals. We also see some evidence over time of more females entering the labor force. While men are more likely to be working, the male coefficient falls between 1988 and 1995 across most industries. The industry constants, which are pooled and used in the second stage, are summarized in Table 4b.

One concern that is typically voiced with respect to multinomial logit models such as (2) is that they assume that the odds ratios of any two possibilities (p_j/p_k) are independent of the number and nature of alternative outcomes. This is known as the independence of irrelevant alternatives (IIA) hypothesis. When alternative polychotomous discrete choice models that do not make this assumption, such as multinomial probits, are unstable or display convergence problems, one can test for the validity of the assumption using, for instance, the Hausman specification test which, in essence, tests for the stability of parameter estimates as alternative outcomes are excluded from the model. This test failed to reject the null hypothesis (that IIA is satisfied) for 8 out of our 9 outcome categories for 1995. Although results were poorer for 1988, with four rejections of the null, the overall picture is not one of overwhelming rejection of the Multinomial Logit specification.[30]

Table 5 reports the second-stage regression of industry wage premia on effective rates of protection, import penetration, export shares, and import- and export-weighted real exchange rates. All specifications are in first-differences. Import penetration rates and export shares are entered only in lags, so as to reduce possible simultaneity concerns. The basic argument for treating changes in effective rates of protection – the main variable of interest – as exogenous is the same as in Attanasio, Goldberg and Pavcnik (2004) and Pavcnik et al. (2004): trade reforms in Latin America in the late 1980s and early 1990s arose as a response to becoming GATT / WTO members, or to a central policy decision to comply with previously negotiated rules. "This reflects the government's objective to reduce tariffs across industries to more uniform rates negotiated with the WTO. Policymakers accordingly cater less to special lobby interests, so that tariff declines in each industry are proportional to the industry's pre-reform tariff levels (…) alleviating concerns about endogeneity at least in the economic sense" (Goldberg and Pavcnik, 2004, p.4.)

Eight different specifications are presented in Table 5. While ERPs are insignificant when differences are entered contemporaneously, they become robustly statistically significant in first lags (specifications 4 – 8). The coefficients on lagged ERPs have the expected positive sign and are statistically significant at the usual levels, suggesting that larger declines in protection were associated with larger declines in the industry wage

[30] Details from the Hausman specification test are available from the authors on request.

premium over this period in Brazil.[31] Nevertheless, the estimated size of the impact is small: using the ERP coefficient from specification 8, the fall in average ERP from 51.4% in 1988 to 20.0% in 1995 (with all other variables held at their mean values) would result in a 1.6% decrease in average industry wage premium.

Although theory suggests that the pass-through of tariffs to product prices, and thus to wages, is mediated by the sector's import penetration (see Gonzaga et al., 2006), import-penetration does not appear to be important in mediating the effect of tariffs on industry-specific wage premia, as shown by the insignificant coefficients on the interaction terms. The same is not true of (import-weighted) exchange rate effects, which have the predicted (negative) sign[32] when interacted with lagged import penetration: as the currency appreciates and imports become more competitive for a particular industry, wage premia in that industry decline. When the RER is export-weighted and interacted with lagged export-share, the effect is positive and significant.[33]

Table 6 presents the second-stage results for the regression of industry-specific skill premia on the same set of trade-related variables. For industry-specific skill premia, once the economy-wide returns to skill are controlled for in the first stage, there are no particular theoretical predictions, and we find that the coefficients on ERPs are insignificant across all specifications. Interestingly, however, we find a fairly robust pattern of negative and significant coefficients on lagged import penetration, suggesting that skill premia were falling for those industries where the growth in import penetration was largest. We know that these were largely skill-intensive industries that were most highly protected prior to 1988, as seen in Table 1. This movement in industry-specific skill premia is therefore consistent with the decline in the economy-wide skill premium

[31] Although Pavcnik et al. (2004) expected these results ("The models predict a positive association between industry tariffs and wages, so that declines in industry tariffs lead to proportional declines in industry wages", p.321), they did not find them. This may have been due to their use of the less representative PME data, or to specifications that did not include lagged ERPs. Lagging ERPs accounts for the fact that the effects of reduced protection on industry premia may take time to flow through. Our protection results are, however, consistent with those for Colombia (Attanasio, Goldberg and Pavcnik, 2004), and Mexico (Revenga, 1997).

[32] An increase in our exchange rates means an appreciation in the currency.

[33] This likely reflects the fact that an increase in an industry's export share would be expected to increase that industry's wage premium.

which was documented in Gonzaga et al. (2006), and which we also observe. *Controlling for the growth in import penetration*, there appears to be some evidence that a stronger currency increases the skill premium.[34]

Table 7 reports the second-stage results for the regression of industry participation constants from the employment multinomial logit model on the same set of trade-related variables. These results are somewhat harder to interpret, since the ten occupational categories used in the estimation are much more aggregated than the 22 industries used in the previous two tables, and are basically at the agriculture, manufacturing and services level.[35] Partly as a result, there is a counterintuitive negative sign on lagged ERPs, which suggests a (conditional) movement *towards* the industries experiencing the greater declines in protection. This result is explained by a movement towards the tradable sectors (particularly agriculture) of the reference category of workers in the employment model. Once we look at the unconditional pattern of employment changes for all workers at the disaggregated industry level, in Figure 5, we observe the expected positive correlation: employment levels seem to have fallen by more in industries experiencing larger declines in protection.

The only other statistically significant result in Table 7 is easier to interpret: lagged export shares are positively correlated with conditional increases in employment, suggesting that industries that succeeded in increasing their exports suffered smaller declines in employment than others.

Taken together, these results paint a mixed picture. The signs and significance are broadly – if not wholly – consistent with theoretical expectations from models that feature barriers to labor movement across sectors. Larger falls in protection and an exchange rate that makes imports more competitive domestically imply lower industry

[34] This may be evidence of quality upgrading in the face of increased import competition.

[35] Both formal and informal agriculture categories are regressed on trade variables for the agricultural industry. Formal and informal manufacturing use manufacturing trade variables averaged over the various manufacturing industries, using lagged imports as weights. Formal and informal nontradables, employers and the self-employed categories are assigned zero ERPs, import penetration and export share, but use economy-wide import- and export-weighted real exchange rates.

wage premia. More exports in an industry are associated with increased wage premia and employment. Greater import penetration is associated with falls in wage premia which are greater for more skilled workers (who work mostly in industries that suffered the largest increase in penetration). These results are perhaps more in line with theory and with other accounts of trade liberalization in Brazil than previous attempts at estimating these relationships in Brazil, notably by Pavcnik et al. (2004).

Yet, they leave much to be desired. Empirically, the R^2 of each second stage regression is never higher than 0.12. For the wage equations, they are never higher than 0.04, suggesting that, however economically important the joint variation in the trade variables may be, it accounts for a small share of the observed variation in wage premia across industries and over time. Conceptually, these wage regressions focus on only one of the five mechanisms through which trade reforms are thought to influence changes in wages in developing countries (which were reviewed in Section 2), namely changes in industry specific wage and skill premia.

However, if workers can move across industries over the medium-run, and if market imperfections in labor and product markets are not particularly severe, then it is likely that the main effects of the changes in protection observed in Brazil over this period manifest themselves through (i) worker reallocation across industries and (ii) changes in the economy-wide skill premium. This prediction would accord with the Stolper-Samuelson theorem, but might also be consistent with economy-wide trade-induced SBTC or quality ladder models. In the next section, we turn to the full decomposition of wage changes in Brazil between 1988-1995, in an effort to place the changes implied by the second stage regressions reported in Tables 5-7 into context – both vis-à-vis other changes that may be associated with trade channels, and vis-à-vis other economic processes that are less likely to be driven by trade reforms.

5. Decomposition Results

5.1 The Distribution of Hourly Wages

Table 8 summarizes the results of the decomposition described in Section 3.2. It presents four measures of inequality for the 1988 and 1995 hourly wage distributions in Brazil, as well as for the six intermediate counterfactual distributions previously described. The measures are the $90^{th}/10^{th}$ percentile ratio; the mean log deviation (also known as GE(0), or Theil-L index); the Theil-T index (or GE-1) and the Gini coefficient. Figures 6-11 plot the observed wage growth incidence curve (WGIC) between 1988 and 1995, as well as different counterfactual WGICs, each corresponding to one of the counterfactual distributions listed on Table 8. The figures provide a full-distribution, disaggregated decomposition of wage changes.

The differences between $G(w^1)$ and $G(w^{88})$, which correspond to the impact of the trade-mandated changes in industry-wage premia, are economically insignificant: counterfactual inequality measures hardly move, and the counterfactual WGIC in Figure 6 remains very close to the x-axis. Despite statistically significant coefficients on the tariffs in the second-stage estimation described in the previous section, it appears that changes in the wage distribution due to industry wage premia between 1988 and 1995 were immaterial. The same is true of changes in industry-specific skill-premia, which are incorporated into $G(w^2)$, in Figure 7. Thus, although our second-stage regression coefficients are statistically significant (while theirs are not), we reach the same essential conclusion on the economics of these impacts as Pavcnik et al. (2004): trade liberalization did not affect the Brazilian wage distribution *through industry specific premia.*

But when relative prices and wages change, firms and industries contract and expand in response. Workers flow across sectors and industries, and their movement is highly selective (on observed and unobserved characteristics). The difference between $G(w^2)$ and $G(w^3)$ is meant to capture those occupational (employment) changes which took place in response to changes in trade-related variables (as predicted by the second-stage regressions). These counterfactual changes are much larger than those associated with industry-specific wage and skill-premia. All four inequality measures for $G(w^3)$ move closer to their 1995 values: the difference in inequality between this simulation and 1988 ranges between 51% of the 1995-1988 difference (for p90/p10) and 76% (for the Theil – T). Figure 8 reveals that the bulk of the underestimate is due to the bottom of the distribution: whereas *G(w^3)* generates a remarkably good prediction of changes in the wage distribution from the 20th percentile upwards, it considerably underestimates gains for the bottom quintile.

Allowing for changes in the economy-wide returns to education (and thus in a flexible version of the economy-wide skill premium) contributes to a further reduction in inequality, which now in fact overshoots the 1995 targets (for three of the four measures).[36] Consistent with the decline in returns to higher levels of schooling, this simulation does not affect the bottom of the distribution much, but lowers counterfactual incomes in the middle and at the top (Figure 9).

It is harder to attribute these changes to trade reforms, since this counterfactual imports *observed* 1995 coefficients (on education, as well as on industry dummies and industry skill premia), rather than those mandated by the second-stage. The bulk of the difference between *G(w^3)* and *G(w^4)* is due to β_{ed}^{95} which, by its very nature as an economy-wide vector of returns, does not vary by industry and can not be estimated in a second stage. But the fact that it can not be included in a Pavcnik et al.-style second stage does not mean that it does not reflect trade changes. In fact, as discussed above, if output and labor markets are reasonably well-functioning, a number of theories of trade would predict an important effect of trade liberalization on this coefficient. The Stolper-Samuelson effect would predict a decline in the economy-wide skill premium, and thus an inequality-reduction from importing β_{ed}^{95}. Trade-induced SBTC, as well as most versions of the outsourcing or quality ladder stories would imply an increase in the demand for skilled workers, and thus an increase in inequality from β_{ed}^{95}.

[36] This result is reminiscent of the Gonzaga et al. (2006) finding that trade-mandated changes in the (economy-wide) skill premium were larger than those actually observed.

On the other hand, changes in β_{ed}^{95} clearly also reflect other economic and demographic changes, notably changes in the supply of skilled workers. As shown in Figure 4, there was indeed some growth in the skills of the Brazilian labor force over this period, with the share of skilled workers rising from 20% to 24%. All in all, this decomposition method does not allow us to separate these changes in inequality into components due to each of the alternative trade hypotheses, and a component due to changes in the supply of skills (or to technology changes unrelated to trade). All that can be said is that the net effect suggests that the Stolper-Samuelson channel and the effects of increased skill supply (which go in the same direction) seem to have outweighed any effects of SBTC or quality compositional changes that might have occurred as a result of trade liberalization.

The two final steps in the decomposition incorporate changes in the remainder of the earnings regression coefficients (the other elements of β) to generate $G(w^5)$; and a rank-preserving transformation in the distribution of residuals to generate $G(w^6)$. Finally, the differences between $G(w^6)$ and $G(w^{95})$ are residually due to changes in the joint distribution of observed characteristics (and in their correlation with the unobserved, including selection). Although effects of trade on the returns to experience, or to unobserved skills, can not be ruled out, these are not channels on which the literature has focused. Accordingly, we interpret these remaining changes as those which are not attributable to trade effects. Changes in non-education returns are mildly equalizing, and poverty-reducing. Changes in the distribution of residuals contribute to lower incomes in the middle of the distribution and higher incomes at the very top. The net effect is mildly inequality increasing (except for p90/p10). The effect of changes in the distribution of observed characteristics further lowers incomes in the middle of the distribution and raises them above the 75th percentile.

5.2. The Distribution of Household Income per Capita

Once the six counterfactual wage distributions $G(w^1)$ to $G(w^6)$ have been simulated, it is a simple matter to create the corresponding counterfactual distributions of household income per capita. Household identifiers link each worker in our data set to a particular household, and information is available on all of its other sources of income (subject to the usual misreporting and measurement issues in an income survey like the PNAD). It is therefore possible to simulate the impact of these counterfactual changes in wages on the distribution of household incomes, and on the inequality and poverty levels associated with it. These results are reported on Table 9, and in Figures 12-17, for the same inequality indices used so far and for the three standard FGT poverty measures. We adopt a relative poverty line of R$87.55 in 2004 prices, which corresponds to 50% of the 1988 median household per capita income.

Before discussing these results, it is important to recognize that their limitations are even greater than those for the wage distribution decompositions analyzed so far. In addition to the same caveat about path dependence, now the absence of general equilibrium effects extends to any indirect impacts of trade (or any other changes) on family composition, or on the occupational decisions of household members other than spouses. There are also important changes in other, unrelated policy parameters, such as the real value of pension payments and other transfers, which are consigned to the residual – which is therefore larger than in the decomposition described in Table 8.

As in the hourly wage distribution, trade-mandated changes in industry wage premia and industry-specific skill premia have very limited effects (although they are somewhat more inequality increasing, suggesting that the workers hardest-hit by wage declines in contracting industries belonged to poorer households: Figures 12 and 13). The biggest impact, as before, comes in the transition from the second to the third counterfactual (Figure 14). The changes in occupations across the distribution which occur in response to changes in the occupation-specific terms in the multinomial logit model are vastly poverty- and inequality-reducing. They contribute a decline of six points in the headcount index, actually overshooting the observed decline. Inequality measures move very close to the observed 1995 values, and the counterfactual growth incidence curve corresponding to these "full trade effects" lies quite close to the observed GIC (1995-1988).

Allowing for changes in the returns to education β_{ed}^{95} in simulation 4 contributes to a further reduction in inequality, as in the wage distribution, and to an under-prediction of all, but particularly the highest, incomes (Figure 15). That is partly corrected by allowing the other earnings regression coefficients (including the constant) to take their 1995 values (Figure 16). Finally, replacing the earnings regression residuals with a rank preserving transformation of the 1995 residuals leads to column HPCI (6) in Table 9, and to the counterfactual GIC in Figure 17.

The underestimates in poverty and inequality implied in this final counterfactual reflect two main factors. First, there were substantial changes in labor force participation and informality over this period which were unrelated to trade and are thus not captured by the simulation. Second, there were also important changes in the incidence of non-labor incomes, with a decline in the real value of minimum-wage linked pensions at the bottom of the distribution, and an increase in the real value of retirement earnings at the top. Both of these trends, which were documented in Ferreira and Barros (1999), help account for the difference between the counterfactual and the actual GICs in Figure 17 (and between the two bottom lines of Table 9).

These earnings-based simulations are *not* the most suitable way for understanding differences between full household income distributions. The extended version of this approach which is described in Bourguignon et al. (2004) would be much more appropriate.[37] The point of this subsection, then, was merely to point out that the links between trade – and, in particular, trade-mandated employment flows across sectors and formality status – and wage inequality do appear to carry through to the changes we have observed in the distribution of HPCY in Brazil over this period, including a substantial part of the observed poverty reduction.

[37] Yet another alternative approach would be to decompose (both the actual and counterfactual) changes in inequality between 1988 and 1995 into "horizontal" and "vertical" components. The former reflect differences in the income *changes* affecting households at similar initial levels of welfare, while the latter captures differences in (conditional mean) changes across different levels in the initial welfare distribution. See Ravallion and Lokshin (2004) for a specific decomposition, applied to a (counterfactual) trade reform in Morocco.

6. Conclusions

Using a nationally representative sample of workers in all sectors of the economy, this paper has sought to quantify the impacts of the 1988-1995 trade liberalization episode on the Brazilian wage distribution. Our results confirm previous findings that changes in industry wage premia and industry-specific skill premia did not meaningfully contribute to changes in the distribution of hourly wages. Trade reforms *did* contribute to the observed reduction in inequality, but this happened through other channels. Chief among them were trade-induced changes in employment levels across sectors, industries and formality categories (formal, informal, self-employed, employer). The reallocation of workers that our model predicts to have arisen from changes in levels of protection, exchange rates, import penetration and export shares between 1988 and 1995 accounts for more than half of the observed changes in three out of four measures of inequality in hourly wages.

The other key channel through which trade reform is likely to have affected the distribution of wages is through changes in the economy-wide skill premium. This is the channel on which Gonzaga et al. (2006) focused, and they argued that changes in the skill premium mandated by a Stolper-Samuelson model of trade would account for more than the actual change in skill-premium *in manufacturing* during 1988-1995. While our approach is unable to identify changes in the economy-wide skill premium which are due to trade variables from those which are not, our findings are consistent with the Gonzaga et al. results: returns to education fell over the period, contributing to a decline in inequality which did overshoot the observed decline. If there was any skill-biased technical change, or if other forces for greater demand for skill were at work, they were more than offset by the joint force of the Stolper-Samuelson effect of trade liberalization in an economy that used to protect skill-intensive industries, and of increases in the supply of more educated workers.

Overall, even if one does not attribute the decline in the economy-wide returns to education to the trade reforms (despite evidence from other sources that part of it is attributable to the Stolper Samuelson effect), our results suggest that trade liberalization did play an important part in the reduction of wage inequality in Brazil during 1988-1995. The counterfactual wage growth incidence curve that includes the combined wage and employment effects mandated by changes in trade variables accounted for 59% of the observed change in the Theil-L index; 61% of the change in the Gini coefficient; and 76% of the change in the Theil-T index. Among the combined effects, changes in occupation and employment levels across industries were by far the most important. These reductions in wage inequality did appear to extend to declines in household income inequality, and in the poverty rate.

Some of the implications of these findings are as follows. There is no reason why researchers concerned with the distributional effects of trade liberalization should focus exclusively on the manufacturing sector; or only on industry-specific wage premia. Indeed, it would seem that employment flows and changes in the occupational structure of the labor force play a central role, and should be considered explicitly. For policy-makers, it would seem that in countries where protection was stronger for industries intensive in skilled workers (which was not the case in Mexico, Chile or Colombia, but was the case in Brazil), there need be no mandatory trade-off between gains in efficiency and productivity on the one hand, and increases in inequality or poverty on the other. Quite the contrary: the same liberalization efforts that lead to productivity gains may also lead to wage gains at the bottom of the distribution, and to reductions in poverty and inequality.

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Table 1: Trade Variables by Industry, 1988 and 1995

	Nom. Tariffs		ERP		Imp. Pen.		Exp. Share		M-RER		X-RER	
Industry	88	95	88	95	88	95	88	95	88	95	88	95
Agricultural products	17	7	15	8	NA	NA	NA	NA	5,347	7,351	110	193
Mining products	20	3	15	0	8	12	98	77	149	196	135	209
Oil and coal extraction	6	0	-3	-2	130	117	0	1	16	24	441	777
Non-metallic minerals	39	10	46	12	1	3	2	4	105	169	180	297
Steel, non-ferrous and other metallurgy prdts.	33	11	37	14	3	7	28	28	92	131	6,021	8,158
Machinery and tractors	47	19	50	18	14	31	18	36	105	172	232	324
Electrical equipment, electronic equipment	50	21	59	30	12	18	7	10	56	86	114	182
Auto., trucks and buses; parts, comp. and other vehicles	43	31	45	74	9	16	13	12	91	147	296	414
Wood products and furniture	30	11	29	12	0	1	4	10	311	540	29	45
Cellulose, paper and printing	32	10	30	10	2	6	6	11	40	55	143	221
Rubber products	49	13	59	15	4	10	6	8	195	299	248	414
Chemical elements and products	66	15	76	16	56	87	33	39	30	46	118	189
Oil refining and petrochemicals	34	4	70	3	12	30	31	7	103	392	96	160
Pharmaceutical and perfumery products	45	8	52	8	6	13	2	3	45	73	208	346
Plastic products	57	15	72	21	2	7	2	3	60	92	311	435
Textile products	57	15	84	22	10	59	27	29	217	334	164	264
Apparel	76	20	94	24	0	3	1	2	162	253	109	185
Footwear	41	18	40	24	3	7	25	36	479	708	18	31
Processing of vegetal products	42	12	86	16	9	15	21	15	112	146	65	111
Meat packing, dairy industry, vegetal and other food products	63	20	73	21	3	7	50	47	52	83	85	140
Unclassified manufacturing	49	14	64	15	0	0	0	0	101	169	102	265
Simple average	44	17	52	21	19	28	22	22	390	566	456	652
Nontradables	0	0	0	0	0	0	0	0	67	104	91	147

Sources: Nominal tariffs and effective rates of protection from Kume et al. (2000), reported in Abreu (2004); import penetration and export share of production from Muendler (2003); import- and export-weighted real exchange rates are authors' calculations from World Development Indicators (World Bank, 2006) and COMTRADE (UN, 2006). For more details, see Data Appendix.

Table 2: Industry Concordance

Trade Industry (Kume et al)	PNAD Code	PNAD Industry	Final Code	Final Industry
Agricultural products	11-42	Various crops, horticulture and forestry	1	Agricultural products
Mining products	50, 53-59	Prospecting and extraction of non-oil/gas/coal minerals	2	Mining products
Oil and coal extraction	51-52	Oil, gas and coal	3	Oil and coal extraction
Non-metallic minerals	100	Non-metal processing	4	Non-metallic minerals
Steel products	110	Steel products	5	Steel, non-ferrous and other metal products
Non-ferrous metallurgy	110	Non-steel metals products	5	Steel, non-ferrous and other metal products
Other metallurgical products	110		5	Steel, non-ferrous and other metal products
Machinery and tractors	120	Manufacture of machines and equipment	6	Machinery and tractors
Electrical equipment	130	Manufacture of electrical and electronic equipment	7	Electrical and electronic equipment
Electronic equipment	130	Manufacture of electrical and electronic equipment	7	Electrical and electronic equipment
Automobiles, trucks and buses	140	Manufacture of vehicles and parts	8	Automobiles, trucks and buses; parts, comp. and other vehicles
Parts, components and other vehicles	140	Manufacture of vehicles and parts	8	Automobiles, trucks and buses; parts, comp. and other vehicles
Wood products and furniture	150, 151, 160	Manufacture of wood products and furniture	9	Wood products and furniture
Cellulose, paper and printing	170, 290	Pulp and paper products, printing and newspapers	10	Cellulose, paper and printing
Rubber products	180	Rubber products	11	Rubber products
Chemical elements	200	Chemical products	12	Chemical elements and products
Oil refining	201	Oil and petroleum products	13	Oil refining and petrochemicals
Chemical products	200	Chemical products	12	Chemical elements and products
Pharmaceutical and perfumery products	210, 220	Pharmaceuticals and toiletries	14	Pharmaceutical and perfumery products
Plastic products	230	Plastics	16	Plastic products
Textile products	240, 241	Textiles	17	Textile products
Apparel	250	Apparel and clothing	18	Apparel
Footwear	251	Footwear	19	Footwear
Coffee industry			21	Meat packing, dairy industry, vegetal and other food products
Processing of vegetal products	280	Tobacco and other vegetal processing	20	Processing of vegetal products
Meat packing	260	Food preparation	21	Meat packing, dairy industry, vegetal and other food products
Dairy industry	260	Food preparation	21	Meat packing, dairy industry, vegetal and other food products
Sugar	17?	Sugar cane extraction?	21	Meat packing, dairy industry, vegetal and other food products
Vegetal products	260		21	Meat packing, dairy industry, vegetal and other food products
Other food products	260, 261, 271	Other foods and drinks	21	Meat packing, dairy industry, vegetal and other food products
Other industries	300	Various scientific instruments	99	Unclassified manufacturing
	340-903	Construction, services, retail, finance, government etc.	22	Nontradables
Omitted	190	Leather and skins		
	202	Manufacture of synthetic materials (nylon etc)		

Table 3a: First Stage Regression Results: Wages

	1987	1988	1989	1990	1992	1993	1995	1996	1997	1998	1999
Male	0.321	0.32	0.336	0.297	0.249	0.271	0.222	0.214	0.228	0.214	0.216
	(0.007)***	(0.007)***	(0.007)***	(0.007)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.005)***
Experience	0.048	0.047	0.045	0.044	0.038	0.039	0.036	0.036	0.036	0.034	0.035
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Experience squared	-0.001	-0.001	-0.001	-0.001	0	0	0	0	0	0	0
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
White	0.135	0.143	0.185	0.157	0.139	0.153	0.156	0.165	0.165	0.159	0.161
	(0.005)***	(0.005)***	(0.006)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.004)***
Yellow	0.294	0.318	0.319	0.303	0.264	0.348	0.346	0.398	0.439	0.351	0.285
	(0.035)***	(0.038)***	(0.044)***	(0.038)***	(0.042)***	(0.040)***	(0.040)***	(0.043)***	(0.046)***	(0.035)***	(0.040)***
1-3 years education	0.213	0.19	0.203	0.195	0.143	0.172	0.145	0.146	0.14	0.144	0.124
	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.008)***	(0.009)***	(0.009)***	(0.008)***	(0.008)***
4 years education	0.393	0.4	0.398	0.392	0.324	0.356	0.307	0.304	0.288	0.281	0.266
	(0.009)***	(0.010)***	(0.010)***	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.009)***
5-7 years education	0.578	0.582	0.573	0.561	0.463	0.496	0.436	0.406	0.41	0.398	0.373
	(0.011)***	(0.011)***	(0.011)***	(0.011)***	(0.010)***	(0.010)***	(0.009)***	(0.010)***	(0.009)***	(0.009)***	(0.009)***
Completed primary	0.815	0.812	0.806	0.767	0.666	0.709	0.628	0.605	0.602	0.586	0.547
	(0.012)***	(0.013)***	(0.013)***	(0.012)***	(0.011)***	(0.012)***	(0.011)***	(0.011)***	(0.011)***	(0.010)***	(0.010)***
9-10 years education	0.955	0.967	0.981	0.944	0.82	0.848	0.746	0.741	0.726	0.705	0.664
	(0.015)***	(0.015)***	(0.016)***	(0.015)***	(0.014)***	(0.014)***	(0.013)***	(0.013)***	(0.012)***	(0.012)***	(0.012)***
Completed high school	1.23	1.274	1.224	1.096	0.933	1.047	0.968	1.002	1.001	0.938	0.896
	(0.058)***	(0.060)***	(0.061)***	(0.049)***	(0.047)***	(0.049)***	(0.047)***	(0.047)***	(0.047)***	(0.046)***	(0.041)***
12-14 years education	1.623	1.691	1.656	1.511	1.283	1.426	1.39	1.439	1.404	1.35	1.307
	(0.060)***	(0.062)***	(0.063)***	(0.051)***	(0.049)***	(0.052)***	(0.049)***	(0.049)***	(0.049)***	(0.048)***	(0.043)***
Completed university	2.05	2.147	2.05	1.915	1.649	1.82	1.791	1.824	1.814	1.761	1.738
	(0.059)***	(0.061)***	(0.062)***	(0.050)***	(0.049)***	(0.051)***	(0.048)***	(0.049)***	(0.048)***	(0.047)***	(0.042)***
Formal employee	0.22	0.333	0.237	0.17	0.401	0.357	0.184	0.182	0.198	0.207	0.228
	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.005)***	(0.006)***	(0.005)***	(0.005)***	(0.005)***
Self-employed	0.274	0.295	0.338	0.319	0.302	0.337	0.257	0.268	0.205	0.184	0.197
	(0.008)***	(0.008)***	(0.008)***	(0.008)***	(0.007)***	(0.008)***	(0.007)***	(0.007)***	(0.007)***	(0.007)***	(0.006)***
Employer	0.966	0.974	1.07	0.938	0.925	0.972	0.938	0.903	0.908	0.853	0.876
	(0.018)***	(0.019)***	(0.017)***	(0.015)***	(0.016)***	(0.016)***	(0.014)***	(0.016)***	(0.014)***	(0.014)***	(0.014)***
Northeast region	-0.369	-0.353	-0.441	-0.443	-0.291	-0.404	-0.29	-0.276	-0.296	-0.228	-0.244
	(0.009)***	(0.010)***	(0.010)***	(0.010)***	(0.011)***	(0.011)***	(0.010)***	(0.010)***	(0.010)***	(0.010)***	(0.009)***
Southeast region	-0.077	-0.025	-0.092	-0.124	0.097	-0.021	0.072	0.105	0.1	0.13	0.112
	(0.009)***	(0.009)***	(0.010)***	(0.009)***	(0.010)***	(0.010)**	(0.010)***	(0.010)***	(0.009)***	(0.009)***	(0.009)***
South region	-0.146	-0.107	-0.16	-0.165	0.063	0.026	-0.003	0.013	0.034	0.055	0.02
	(0.010)***	(0.011)***	(0.011)***	(0.011)***	(0.011)***	(0.011)**	-0.01	-0.011	(0.010)***	(0.010)***	(0.010)**
Central West region	-0.019	-0.005	-0.079	-0.045	0.055	0.068	0.014	0.055	0.047	0.064	0.042
	(0.010)*	-0.01	(0.011)***	(0.010)***	(0.011)***	(0.011)***	-0.01	(0.011)***	(0.010)***	(0.010)***	(0.010)***
Metropolitan residence	0.319	0.331	0.328	0.313	0.302	0.307	0.321	0.326	0.317	0.295	0.252
	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.008)***	(0.009)***	(0.008)***	(0.008)***	(0.008)***
Urban residence	0.198	0.127	0.146	0.158	0.135	0.145	0.157	0.15	0.122	0.108	0.091
	(0.008)***	(0.009)***	(0.009)***	(0.008)***	(0.009)***	(0.009)***	(0.008)***	(0.008)***	(0.008)***	(0.007)***	(0.007)***
Head of household	0.208	0.203	0.193	0.189	0.159	0.166	0.175	0.17	0.156	0.156	0.149
	(0.007)***	(0.007)***	(0.007)***	(0.007)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.005)***	(0.005)***	(0.005)***
Industry indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry*Skill indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	112,655	112,730	114,961	116,882	118,075	119,949	128,360	124,017	131,202	129,719	133,310
R-squared	0.59	0.59	0.57	0.58	0.55	0.55	0.56	0.54	0.56	0.56	0.56

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Dependent variable is real hourly wages from principal job.
Regions are relative to North region. White and yellow are relative to Black. Educational attainment indicators are relative to no education.
Informal employee and self-employed coefficients are relative to formal employees.

Table 3b: First Stage Regression Results: Industry Wage Premiums

Industry	1987	1988	1989	1990	1992	1993	1995	1996	1997	1998	1999
Mining products	0.514	0.578	0.488	0.433	0.238	0.315	0.316	0.213	0.347	0.393	0.349
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Oil and coal extraction	0.678	0.666	0.680	0.727	0.835	0.874	0.817	1.043	0.677	0.824	0.994
	(0.009)	(0.011)	(0.010)	(0.011)	(0.013)	(0.018)	(0.012)	(0.018)	(0.019)	(0.013)	(0.018)
Non-metallic minerals	0.202	0.203	0.225	0.242	0.188	0.191	0.274	0.269	0.353	0.353	0.314
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Steel, non-ferrous and other metallurgy prdts.	0.398	0.398	0.373	0.458	0.381	0.378	0.476	0.484	0.494	0.492	0.432
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Machinery and tractors	0.538	0.539	0.520	0.636	0.406	0.473	0.516	0.508	0.562	0.504	0.495
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Electrical equipment, electronic equipment	0.467	0.493	0.450	0.614	0.507	0.404	0.551	0.503	0.611	0.577	0.458
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Auto., trucks and buses; parts, comp. and other vehicles	0.509	0.608	0.529	0.680	0.646	0.590	0.685	0.692	0.662	0.657	0.628
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Wood products and furniture	0.035	0.020	0.041	0.157	0.091	0.131	0.274	0.299	0.290	0.303	0.298
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cellulose, paper and printing	0.325	0.382	0.328	0.437	0.410	0.343	0.484	0.456	0.512	0.490	0.466
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Rubber products	0.480	0.536	0.325	0.515	0.293	0.387	0.553	0.665	0.433	0.394	0.473
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.005)	(0.002)	(0.005)	(0.005)
Chemical elements and products	0.410	0.326	0.300	0.394	0.383	0.288	0.421	0.421	0.458	0.403	0.454
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Oil refining and petrochemicals	0.563	0.709	0.600	0.571	0.696	0.677	0.532	0.508	0.566	0.511	0.554
	(0.010)	(0.008)	(0.011)	(0.007)	(0.007)	(0.009)	(0.008)	(0.007)	(0.004)	(0.005)	(0.011)
Pharmaceutical and perfumery products	0.343	0.418	0.294	0.396	0.431	0.445	0.434	0.485	0.565	0.533	0.521
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)
Plastic products	0.360	0.364	0.382	0.465	0.315	0.317	0.423	0.375	0.425	0.435	0.374
	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Textile products	0.153	0.239	0.207	0.253	0.195	0.223	0.321	0.285	0.386	0.338	0.184
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Apparel	0.267	0.310	0.334	0.482	0.267	0.259	0.331	0.317	0.380	0.342	0.310
	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Footwear	0.210	0.121	0.278	0.412	0.253	0.176	0.249	0.268	0.271	0.209	0.237
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Processing of vegetal products	0.306	0.360	0.192	0.276	0.522	0.408	0.640	0.477	0.426	0.446	0.174
	(0.013)	(0.008)	(0.014)	(0.008)	(0.008)	(0.011)	(0.007)	(0.010)	(0.005)	(0.014)	(0.006)
Meat packing, dairy industry, vegetal and other food product	0.151	0.169	0.166	0.270	0.180	0.225	0.298	0.316	0.328	0.331	0.277
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unclassified manufacturing	0.068	0.065	0.100	0.160	0.080	0.071	0.095	0.196	0.159	0.147	0.103
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Nontradables	0.164	0.149	0.149	0.300	0.184	0.171	0.306	0.328	0.371	0.367	0.327
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Standard errors are in brackets.

Table 3c: First Stage Regression Results: Industry Skill Premiums

Industry	1987	1988	1989	1990	1992	1993	1995	1996	1997	1998	1999
Mining products	0.089	0.108	0.267	0.400	0.462	-0.052	0.163	0.258	0.180	0.326	0.220
	(0.018)	(0.013)	(0.010)	(0.014)	(0.015)	(0.018)	(0.014)	(0.017)	(0.013)	(0.011)	(0.012)
Oil and coal extraction	0.465	0.411	0.537	0.495	0.293	0.202	0.151	0.039	0.380	0.143	0.081
	(0.020)	(0.022)	(0.021)	(0.029)	(0.023)	(0.030)	(0.022)	(0.031)	(0.032)	(0.028)	(0.025)
Non-metallic minerals	0.123	0.184	0.162	0.090	0.144	0.130	0.225	0.184	0.059	0.044	0.107
	(0.008)	(0.011)	(0.013)	(0.009)	(0.009)	(0.008)	(0.006)	(0.007)	(0.007)	(0.005)	(0.005)
Steel, non-ferrous and other metallurgy prdts.	0.030	-0.071	0.096	0.125	0.148	0.132	0.090	-0.020	0.000	0.037	0.051
	(0.005)	(0.005)	(0.006)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Machinery and tractors	-0.080	-0.119	-0.121	0.020	0.218	0.082	0.050	-0.008	-0.014	0.036	0.001
	(0.006)	(0.008)	(0.008)	(0.006)	(0.005)	(0.007)	(0.006)	(0.005)	(0.004)	(0.004)	(0.004)
Electrical equipment, electronic equipment	0.082	0.073	0.069	0.113	0.039	0.104	0.093	-0.035	-0.052	0.031	0.096
	(0.006)	(0.007)	(0.007)	(0.005)	(0.007)	(0.006)	(0.005)	(0.006)	(0.005)	(0.005)	(0.004)
Auto., trucks and buses; parts, comp. and other vehicles	-0.007	-0.018	-0.072	-0.014	0.113	0.253	0.020	-0.104	-0.010	0.056	0.001
	(0.006)	(0.007)	(0.007)	(0.005)	(0.006)	(0.006)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)
Wood products and furniture	-0.051	0.036	-0.125	0.121	0.050	0.020	-0.008	-0.179	-0.218	-0.059	-0.143
	(0.010)	(0.009)	(0.009)	(0.007)	(0.006)	(0.007)	(0.007)	(0.006)	(0.006)	(0.005)	(0.003)
Cellulose, paper and printing	-0.046	-0.131	0.000	0.046	0.006	-0.079	0.032	-0.069	-0.067	0.005	-0.067
	(0.006)	(0.008)	(0.007)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)
Rubber products	-0.025	-0.273	0.054	-0.136	0.109	0.337	0.158	-0.018	0.179	0.258	-0.197
	(0.032)	(0.029)	(0.022)	(0.026)	(0.025)	(0.015)	(0.017)	(0.021)	(0.024)	(0.015)	(0.021)
Chemical elements and products	0.155	0.175	0.223	0.282	0.254	0.327	0.225	0.173	0.139	0.156	0.073
	(0.007)	(0.008)	(0.007)	(0.006)	(0.006)	(0.007)	(0.005)	(0.007)	(0.006)	(0.008)	(0.005)
Oil refining and petrochemicals	0.456	0.216	0.074	0.374	0.287	0.201	0.294	0.215	0.380	0.308	0.250
	(0.019)	(0.015)	(0.026)	(0.015)	(0.017)	(0.016)	(0.017)	(0.017)	(0.013)	(0.012)	(0.018)
Pharmaceutical and perfumery products	0.088	-0.057	0.184	0.211	0.193	0.078	0.243	0.152	-0.052	0.111	0.066
	(0.011)	(0.012)	(0.015)	(0.012)	(0.011)	(0.012)	(0.011)	(0.010)	(0.011)	(0.008)	(0.007)
Plastic products	0.050	0.110	-0.080	0.170	0.125	-0.084	0.133	0.074	0.055	-0.030	0.043
	(0.018)	(0.014)	(0.022)	(0.010)	(0.010)	(0.011)	(0.011)	(0.010)	(0.010)	(0.008)	(0.006)
Textile products	-0.002	0.153	0.086	0.117	0.235	0.145	0.181	0.143	-0.099	0.002	0.123
	(0.010)	(0.009)	(0.009)	(0.007)	(0.007)	(0.008)	(0.007)	(0.009)	(0.007)	(0.008)	(0.006)
Apparel	-0.185	-0.288	-0.224	-0.116	-0.160	-0.242	-0.230	-0.289	-0.119	-0.194	-0.135
	(0.008)	(0.008)	(0.009)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.003)
Footwear	-0.058	-0.062	-0.024	0.061	-0.105	-0.113	-0.155	-0.084	-0.157	-0.054	-0.153
	(0.019)	(0.015)	(0.018)	(0.009)	(0.010)	(0.010)	(0.010)	(0.012)	(0.009)	(0.007)	(0.006)
Processing of vegetal products	0.126	0.024	-0.069	0.329	0.242	0.001	-0.280	0.117	0.229	0.257	0.332
	(0.025)	(0.041)	(0.024)	(0.031)	(0.023)	(0.022)	(0.047)	(0.022)	(0.032)	(0.032)	(0.017)
Meat packing, dairy industry, vegetal and other food product:	0.000	-0.009	0.019	0.010	0.125	-0.003	0.069	-0.064	-0.006	0.016	0.032
	(0.005)	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Unclassified manufacturing	0.110	0.056	0.282	0.357	0.233	0.035	0.232	0.081	0.140	0.137	0.167
	(0.008)	(0.012)	(0.010)	(0.008)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)
Nontradables	0.194	0.141	0.185	0.265	0.204	0.158	0.130	0.055	0.053	0.095	0.101
	(0.003)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)

Standard errors are in brackets.

Table 4a: First Stage Regression Results, 1988 and 1995: Employment multinomial logit - Marginal Effects

					1988					
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Probability (at mean)	**0.329**	**0.026**	**0.186**	**0.046**	**0.013**	**0.016**	**0.080**	**0.108**	**0.173**	**0.022**
Male		0.009***	0.137***	0.091***	0.025***	0.017***	0.081***	-0.010***	0.087***	0.032***
Experience		0.001***	0.005***	-0.001***	0.000***	-0.001***	0.008***	-0.010***	0.015***	0.005***
Experience squared		0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
White		-0.008***	0.013***	-0.015***	-0.002***	-0.001	0.005***	-0.031***	-0.026***	0.015***
Yellow		-0.030***	0.093*	0.042**	-0.032***	0.003	0.006	-0.098***	-0.076***	0.022***
1-3 years education		0.007***	-0.013	-0.030***	-0.004***	-0.001	0.020***	0.007***	0.032***	0.013***
4 years education		0.005***	-0.010***	-0.056***	-0.008***	-0.002	0.039***	-0.003***	0.065***	0.024***
5-7 years education		0.013***	-0.048***	-0.088***	-0.014***	-0.003	0.048***	0.003***	0.088***	0.029***
Completed primary		0.012***	-0.044**	-0.120***	-0.018***	-0.006**	0.051***	-0.005	0.130***	0.040***
9-10 years education		0.009***	-0.071***	-0.130***	-0.026***	-0.009***	0.042***	-0.011	0.165***	0.042***
Completed high school		0.018***	-0.074	-0.131***	-0.017***	-0.011**	0.055***	0.033***	0.222***	0.052***
12-14 years education		0.001	-0.122***	-0.188***	-0.033***	-0.013***	0.046***	0.078***	0.229***	0.054***
Completed university		0.009***	-0.039***	-0.132***	-0.017*	-0.012	0.053***	0.117***	0.238***	0.058***
Region 2		0.008***	-0.013	0.027***	0.014***	0.000	-0.014**	-0.003	-0.002	-0.002
Region 3		0.005***	-0.085***	0.036***	0.030***	-0.005	0.064***	-0.002***	0.024***	0.001***
Region 4		0.009***	-0.021***	0.011***	0.023***	-0.007	0.059***	-0.021***	0.054***	-0.001***
Region 5		0.000	-0.052***	0.038***	0.021***	0.001	-0.048***	0.021***	0.044***	0.003***
Metropolitan residence		0.033***	-0.203***	-0.163***	-0.041***	0.006***	0.099***	0.073***	0.191***	-0.013***
Urban residence		0.026***	-0.198***	-0.069***	-0.019***	0.004***	0.066***	0.082***	0.140***	-0.007***
Head of household		0.004***	0.095***	0.014***	0.014***	0.007***	0.082***	0.065***	0.145***	0.030***
Children 0-14 years in household		-0.003***	-0.011***	-0.001***	0.001***	-0.001***	-0.014***	-0.005***	-0.042***	-0.002***
Has a spouse who works		-0.972***	1.870***	0.439***	0.124	0.159***	0.753***	1.033***	1.660***	0.218***
Observations					177,376					
					1995					
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Probability (at mean)	**0.308**	**0.046**	**0.203**	**0.034**	**0.013**	**0.015**	**0.061**	**0.103**	**0.190**	**0.027**
Male		-0.004***	0.160***	0.073***	0.026***	0.015***	0.061***	-0.040***	0.050***	0.036***
Experience		0.001***	0.008***	0.000***	0.001***	-0.001***	0.007***	-0.005***	0.021***	0.006***
Experience squared		0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
White		-0.008***	0.023	-0.013***	-0.002***	-0.002***	0.003**	-0.022***	-0.028***	0.014***
Yellow		-0.029***	0.114***	0.016	-0.006	-0.008	-0.017**	-0.041***	-0.133***	0.039***
1-3 years education		-0.001***	0.004***	-0.022***	-0.005***	-0.002	0.019***	-0.004***	0.052***	0.010***
4 years education		-0.003***	0.001***	-0.039***	-0.009***	-0.001***	0.034***	-0.017***	0.092***	0.025***
5-7 years education		0.006***	-0.016***	-0.062***	-0.013***	0.000***	0.043***	-0.021	0.115***	0.029***
Completed primary		0.008***	-0.017***	-0.080***	-0.026***	-0.003	0.047***	-0.049***	0.171***	0.038***
9-10 years education		0.008***	-0.042*	-0.095***	-0.031***	-0.007	0.046***	-0.045***	0.206***	0.049***
Completed high school		0.006***	-0.028***	-0.103***	-0.028***	-0.007	0.054***	-0.053***	0.293***	0.059***
12-14 years education		-0.003***	-0.048***	-0.150***	-0.036***	-0.010	0.048***	-0.045	0.321***	0.068***
Completed university		-0.009***	-0.016***	-0.096***	-0.027***	-0.010	0.059***	-0.049***	0.358***	0.075***
Region 2		-0.011	0.016***	0.008***	0.018***	-0.005***	-0.007	0.006***	0.000**	-0.002
Region 3		-0.012***	-0.081***	0.023***	0.035***	-0.004	0.054***	0.002***	0.042***	-0.001***
Region 4		-0.007***	-0.036***	0.014***	0.031***	-0.004	0.062***	-0.003***	0.043***	0.004***
Region 5		-0.006***	-0.071***	0.029***	0.028***	-0.004***	-0.021***	0.020***	0.029***	0.003*
Metropolitan residence		0.054***	-0.216***	-0.108***	-0.049***	0.003	0.048***	0.074***	0.186***	-0.016***
Urban residence		0.045***	-0.216***	-0.047***	-0.019***	0.002***	0.033***	0.077***	0.139***	-0.011***
Head of household		0.011***	0.013***	0.007***	0.012***	0.003***	0.046***	0.040***	0.104***	0.022***
Children 0-14 years in household		0.005***	-0.024***	0.000***	0.001*	-0.001***	-0.003***	-0.007***	-0.028***	-0.005***
Has a spouse who works		-0.055***	0.156***	0.013***	0.005***	0.005***	0.019***	0.021***	0.077***	0.021***
Observations					208,400					

Marginal effects reported. White and yellow are race indicators (black is omitted category); 0 years of education is omitted education category.
Columns headed 0-9 indicate ML results for each employment classification: 0. Not economically active; 1. Unemployed; 2. Self-employed (all industries); 3. Informal agriculture; 4. Formal agricu
5. Informal manufacturing; 6. Formal manufacturing; 7. Informal nontradable sector; 8. Formal nontradable sector; 9. Employer (all industries).

Table 4b: First Stage Regression Results, 1988 and 1995: Employment multinomial logit - industry participation constant

Industry	1987	1988	1989	1990	1992	1993	1995	1996	1997	1998	1999
Unemployed	-4.428	-3.787	-4.476	-4.234	-2.984	-2.783	-2.978	-3.106	-2.802	-2.659	-2.572
	(0.134)***	(0.124)***	(0.142)***	(0.130)***	(0.092)***	(0.092)***	(0.091)***	(0.087)***	(0.080)***	(0.077)***	(0.072)***
Self-employed	-1.157	-1.177	-1.052	-1.168	-1.427	-1.523	-1.75	-2.158	-2.106	-2.135	-2.054
	(0.060)***	(0.060)***	(0.060)***	(0.059)***	(0.057)***	(0.057)***	(0.055)***	(0.055)***	(0.054)***	(0.054)***	(0.053)***
Informal agr.	-1.374	-1.973	-1.39	-1.483	-2.161	-2.253	-2.648	-3.175	-2.949	-2.631	-2.73
	(0.117)***	(0.128)***	(0.125)***	(0.120)***	(0.128)***	(0.125)***	(0.129)***	(0.135)***	(0.128)***	(0.129)***	(0.129)***
Formal agr.	-4.487	-5.104	-4.55	-4.358	-5.934	-6.382	-5.984	-6.483	-7.11	-6.019	-6.919
	(0.240)***	(0.276)***	(0.284)***	(0.236)***	(0.311)***	(0.314)***	(0.291)***	(0.310)***	(0.417)***	(0.294)***	(0.388)***
Informal manuf.	-3.161	-3.059	-3.054	-2.944	-3.73	-3.433	-3.614	-4.07	-4.038	-4.096	-4.408
	(0.141)***	(0.140)***	(0.133)***	(0.139)***	(0.145)***	(0.135)***	(0.138)***	(0.141)***	(0.133)***	(0.140)***	(0.141)***
Formal manuf.	-4.395	-4.462	-4.116	-4.136	-5.138	-5.153	-5.394	-5.524	-5.273	-5.474	-5.302
	(0.091)***	(0.092)***	(0.090)***	(0.091)***	(0.101)***	(0.101)***	(0.102)***	(0.101)***	(0.097)***	(0.102)***	(0.103)***
Informal nontrad.	-1.369	-1.578	-1.456	-1.44	-1.324	-1.206	-1.558	-1.753	-1.744	-1.636	-1.791
	(0.064)***	(0.065)***	(0.065)***	(0.063)***	(0.066)***	(0.062)***	(0.062)***	(0.060)***	(0.059)***	(0.058)***	(0.058)***
Formal nontrad.	-3.123	-2.967	-2.841	-2.919	-3.62	-3.575	-3.802	-3.727	-3.797	-3.802	-3.814
	(0.064)***	(0.063)***	(0.063)***	(0.063)***	(0.062)***	(0.062)***	(0.061)***	(0.058)***	(0.058)***	(0.059)***	(0.058)***
Employer	-7.571	-8.099	-6.581	-6.615	-7.724	-8.007	-7.83	-8.185	-8.477	-8.365	-8.205
	(0.149)***	(0.156)***	(0.128)***	(0.122)***	(0.139)***	(0.145)***	(0.136)***	(0.144)***	(0.137)***	(0.138)***	(0.135)***
Observations	177,399	177,376	179,938	184,724	193,931	197,658	208,400	209,264	219,710	221,088	227,369

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Non-economically active is omitted category.

Table 5: Industry Wage Premiums and Trade Exposure

Dependent variable is industry wage premium	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ERP	0.0005	0.0005	0.0005					
	(0.0005)	(0.0006)	(0.0006)					
ERP * lagged import penetration		-0.0001	-0.0005					
		(0.0019)	(0.0019)					
Lagged ERP				0.0003	0.0003	0.0005	0.0003	0.0005
				(0.0001)*	(0.0001)**	(0.0002)***	(0.0001)**	(0.0002)***
Lagged ERP * lagged import penetration						-0.0015		-0.0015
						(0.0011)		(0.0012)
Lagged import penetration		-0.1531	0.0992		-0.1196	-0.0926	0.1245	0.1508
		(0.1533)	(0.1757)		(0.1452)	(0.1505)	(0.1645)	(0.1746)
Lagged export share		-0.0524	-0.1251		-0.0284	-0.0282	-0.1008	-0.1008
		(0.1313)	(0.1354)		(0.1298)	(0.1306)	(0.1334)	(0.1341)
Lagged imp. pen * lagged imp.weighted RER			-0.001				-0.001	-0.001
			(0.0004)***				(0.0004)***	(0.0004)***
Lagged exp.shr * lagged exp.weighted RER			0.0001				0.0001	0.0001
			(0.0000)**				(0.0000)**	(0.0000)**
Observations	210	207	207	210	207	207	207	207
R-squared	0.01	0.01	0.03	0.01	0.02	0.02	0.03	0.04

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Industry Skill Premiums and Trade Exposure

Dependent variable is industry skill premium	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ERP	-0.0004	0	0					
	(0.0005)	(0.0007)	(0.0007)					
ERP * lagged import penetration		-0.0031	-0.0027					
		(0.0028)	(0.0027)					
Lagged ERP				-0.0003	-0.0004	-0.0004	-0.0003	-0.0004
				(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Lagged ERP * lagged import penetration						-0.0001		0.0002
						(0.0012)		(0.0014)
Lagged import penetration		-0.2762	-0.486		-0.3476	-0.3453	-0.3578	-0.361
		(0.1652)*	(0.1855)***		(0.1509)**	(0.1551)**	(0.1886)*	(0.1928)*
Lagged export share		0.0746	0.1151		0.0445	0.0446	0.0826	0.0826
		(0.1493)	(0.1577)		(0.1510)	(0.1514)	(0.1591)	(0.1595)
Lagged imp. pen * lagged imp.weighted RER			0.001				0.0012	0.0012
			(0.0005)*				(0.0005)**	(0.0005)**
Lagged exp.shr * lagged exp.weighted RER			0				0.0001	0.0001
			(0.0001)				(0.0001)	(0.0001)
Observations	204	201	201	208	201	201	204	204
R-squared	0.00	0.01	0.02	0.01	0.02	0.02	0.02	0.02

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Industry Participation and Trade Exposure

Dependent variable is industry participation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ERP	0.0087	-0.0025	-0.0043					
	(0.0076)	(0.0213)	(0.0229)					
ERP * lagged import penetration		0.0849	0.0965					
		(0.1407)	(0.1574)					
Lagged ERP				-0.0148	-0.0139	-0.015	-0.015	-0.0161
				(0.0041)***	(0.0045)***	(0.0047)***	(0.0069)**	(0.0077)**
Lagged ERP * lagged import penetration						0.0437		0.0483
						(0.0326)		(0.0723)
Lagged import penetration		-1.5541	-0.2417		(1.3357)	(1.2278)	0.4760	1.2010
		(3.9782)	(5.7256)		(1.4342)	(1.5567)	(3.8118)	(4.6518)
Lagged export share		5.9193	4.9226		3.328	4.0074	2.5479	2.9954
		(2.0965)***	(3.4338)		(1.1175)***	(1.0568)***	(2.3503)	(2.3160)
Lagged imp. pen * lagged imp.weighted RER			-0.0091				-0.0049	-0.0024
			(0.0152)				(0.0105)	(0.0080)
Lagged exp.shr * lagged exp.weighted RER			0.0053				-0.0014	0.005
			(0.0183)				(0.0152)	(0.0223)
Observations	80	72	36	72	72	72	36	36
R-squared	0.02	0.02	0.05	0.05	0.06	0.06	0.11	0.12

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8: Actual and Counterfactual Hourly Wage Distributions

	P_{90}/P_{10}	GE(0)	GE(1)	Gini
$w_{ij}^{88} = \exp\left(X_{ij}^{88}\beta^{88} + I_{ij}^{88} * wp_j^{88} + (I_{ij}^{88} * S_{ij}^{88})sp_j^{88} + F_{88}^{-1}(\theta_{i88})\right)$	16.9	0.703	0.780	0.611
$w_{ij}^{1} = \exp\left(X_{ij}^{88}\beta^{88} + I_{ij}^{88} * wp_j^{s} + (I_{ij}^{88} * S_{ij}^{88})sp_j^{88} + F_{88}^{-1}(\theta_{i88})\right)$	16.9	0.705	0.784	0.611
$w_{ij}^{2} = \exp\left(X_{ij}^{88}\beta^{88} + I_{ij}^{88} * wp_j^{s} + (I_{ij}^{88} * S_{ij}^{88})sp_j^{s} + F_{88}^{-1}(\theta_{i88})\right)$	16.7	0.699	0.774	0.609
$w_{ij}^{3} = \exp\left(X_{ij}^{88}\beta^{88} + I_{ij}^{s} * wp_j^{s} + (I_{ij}^{s} * S_{ij}^{88})sp_j^{s} + F_{88}^{-1}(\theta_{i88})\right)$	14.6	0.653	0.731	0.593
$w_{ij}^{4} = \exp\left(X_{ij}^{88}\beta^{s} + I_{ij}^{s} * wp_j^{95} + (I_{ij}^{s} * S_{ij}^{88})sp_j^{95} + F_{88}^{-1}(\theta_{i88})\right)$	12.9	0.600	0.669	0.572
$w_{ij}^{5} = \exp\left(X_{ij}^{88}\beta^{95} + I_{ij}^{s} * wp_j^{95} + (I_{ij}^{s} * S_{ij}^{88})sp_j^{95} + F_{88}^{-1}(\theta_{i88})\right)$	12.3	0.581	0.657	0.566
$w_{ij}^{6} = \exp\left(X_{ij}^{88}\beta^{95} + I_{ij}^{s} * wp_j^{95} + (I_{ij}^{s} * S_{ij}^{88})sp_j^{95} + F_{95}^{-1}(\theta_{i88})\right)$	12.0	0.587	0.691	0.571
$w_{ij}^{95} = \exp\left(X_{ij}^{95}\beta^{95} + I_{ij}^{95} * wp_j^{95} + (I_{ij}^{95} * S_{ij}^{95})sp_j^{95} + F_{95}^{-1}(\theta_{i95})\right)$	12.4	0.617	0.715	0.582

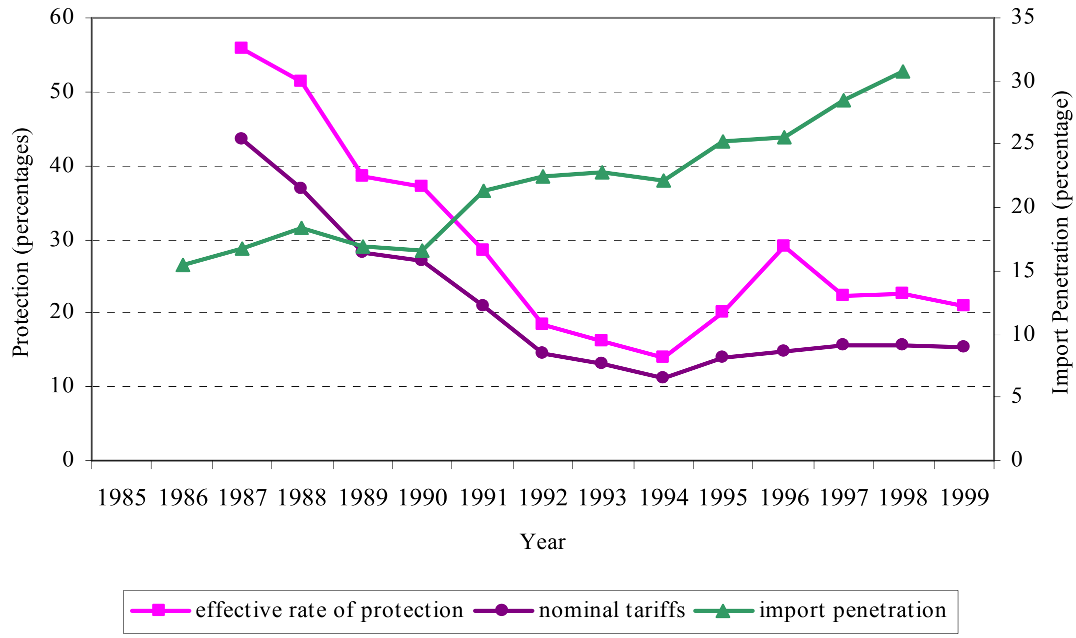
Source: Author's Calculation from PNADs.

Table 9: Actual and Counterfactual Household Per Capita Income Distributions

	P_{90}/P_{10}	GE(0)	GE(1)	Gini	Poverty Line R$87.55		
					FGT(0)	FGT(1)	FGT(2)
$HPCI_{ij}^{88}$	19.3	0.717	0.750	0.609	27.7	11.5	6.7
$HPCI_{ij}^{1}$	19.9	0.729	0.760	0.613	27.7	12.1	7.1
$HPCI_{ij}^{2}$	19.7	0.724	0.755	0.611	27.8	12.1	7.1
$HPCI_{ij}^{3}$	16.9	0.658	0.692	0.589	21.2	8.7	4.9
$HPCI_{ij}^{4}$	15.3	0.613	0.644	0.571	21.2	8.6	4.9
$HPCI_{ij}^{5}$	15.4	0.616	0.645	0.572	19.0	7.6	4.3
$HPCI_{ij}^{6}$	15.2	0.621	0.663	0.575	19.7	7.8	4.4
$HPCI_{ij}^{95}$	16.9	0.660	0.706	0.592	23.8	10.5	6.3

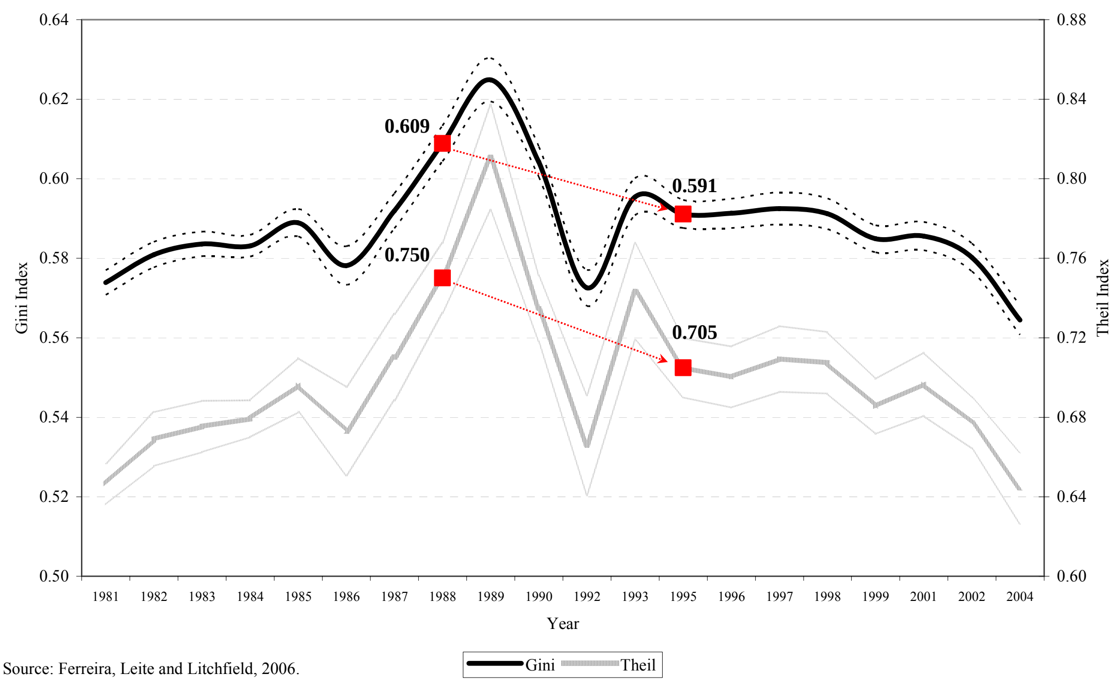
Note: This is a relative poverty line, calculated to represent 50% of the median household per capita income in 1988 (expressed in 2004 prices.
Source: Authors' calculations from the PNAD.

Figure 1: Protection and Import Penetration in Brazil, 1985-1999



Source: Tariffs and rates of protection from Kume et al. (2000) presented in Abreu (2004). Import penetration from Muendler (2003).

Figure 2: Household Per Capita Income Inequality in Brazil, 1981-2004



Source: Ferreira, Leite and Litchfield, 2006.

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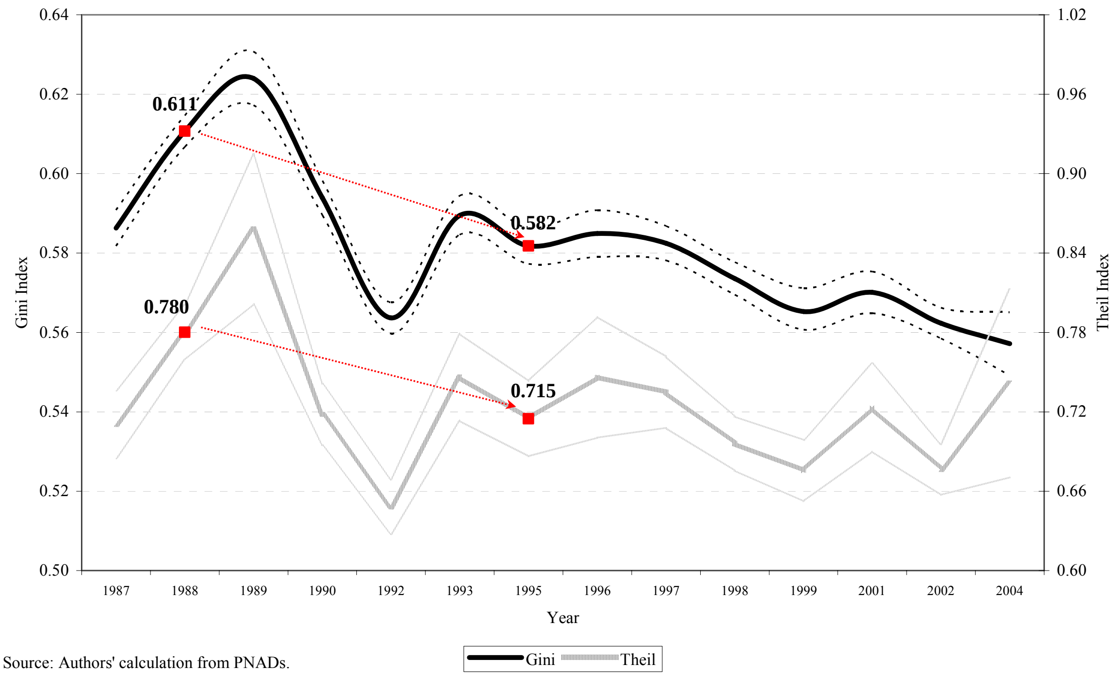
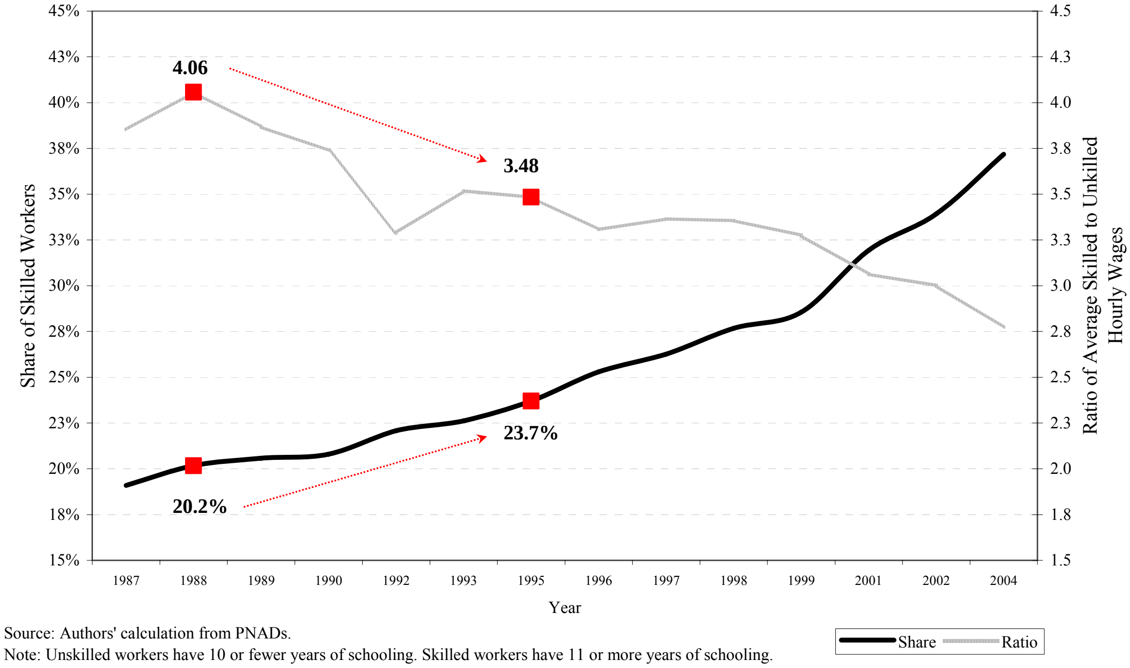
Figure 3: Hourly Wage Inequality in Brazil, 1987-2004



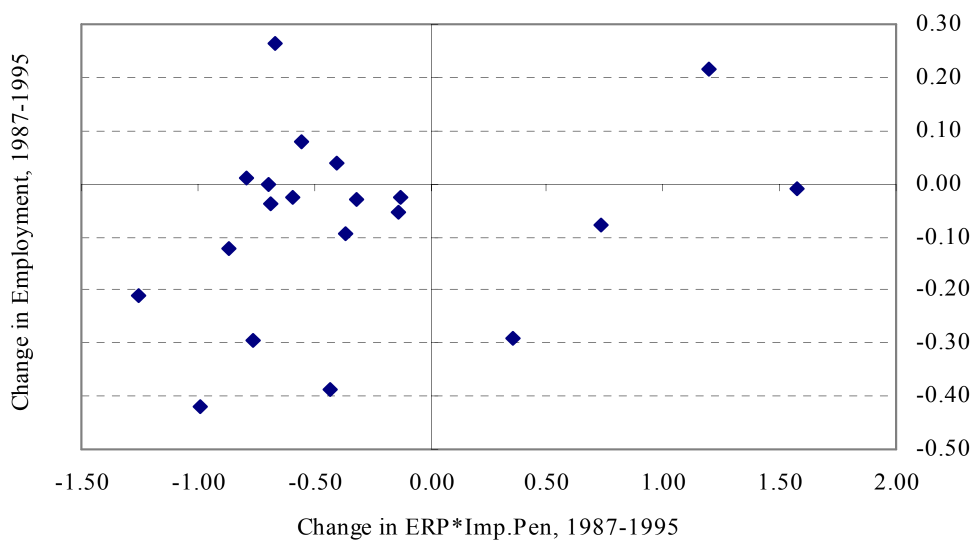
Source: Authors' calculation from PNADs.

Figure 4: Skill Wage Premium and Share of Skilled Workers in Total Employment, 1987-2004



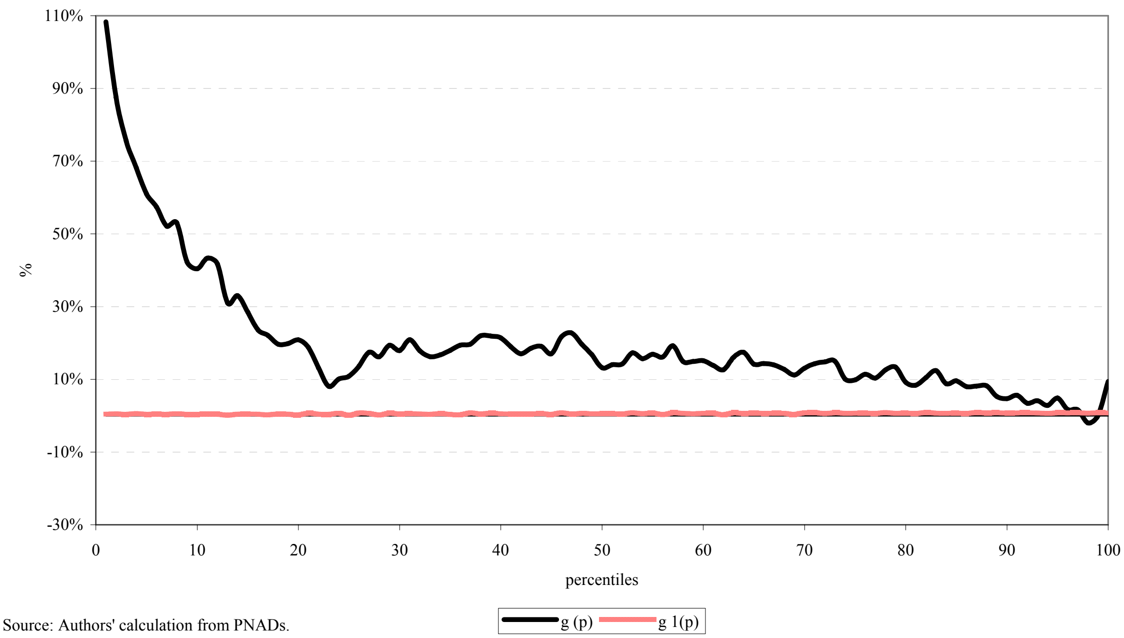
Source: Authors' calculation from PNADs.
Note: Unskilled workers have 10 or fewer years of schooling. Skilled workers have 11 or more years of schooling.

Figure 5: Change in Employment versus Change in ERP*Imp.Pen. by Industry, 1987-1995



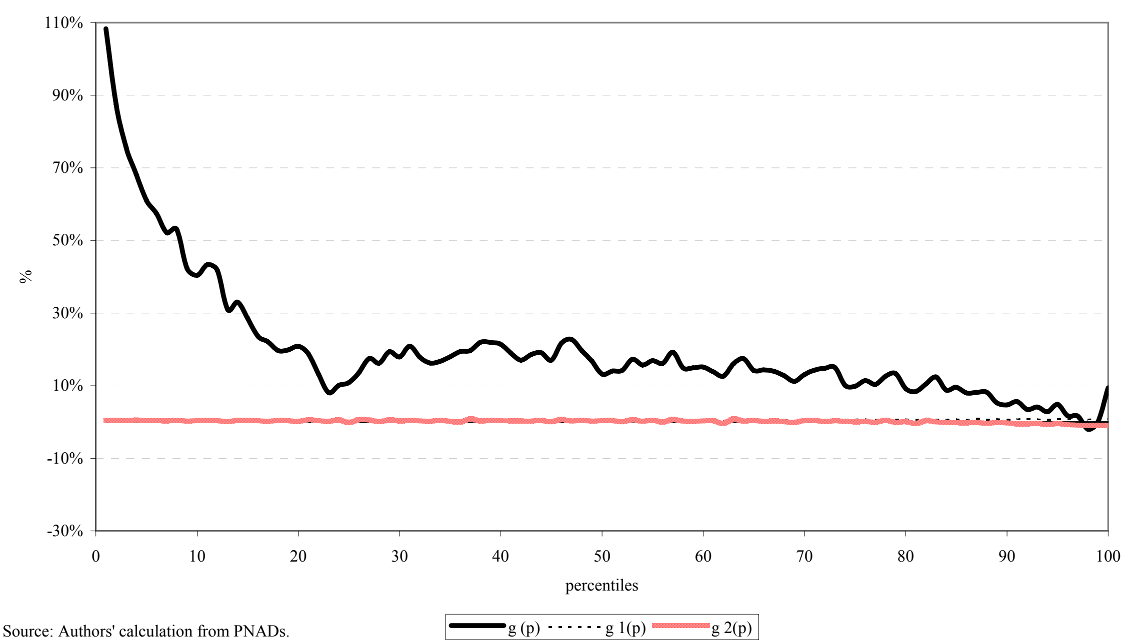
Source: Authors' calculations. Rates of protection from Kume et al. (2000) presented in Abreu (2004); import penetration from Muendler (2003); employment from PNADs.

Figure 6: Observed and counterfactual wage growth incidence curves, 1995-1988: industry wage premia.



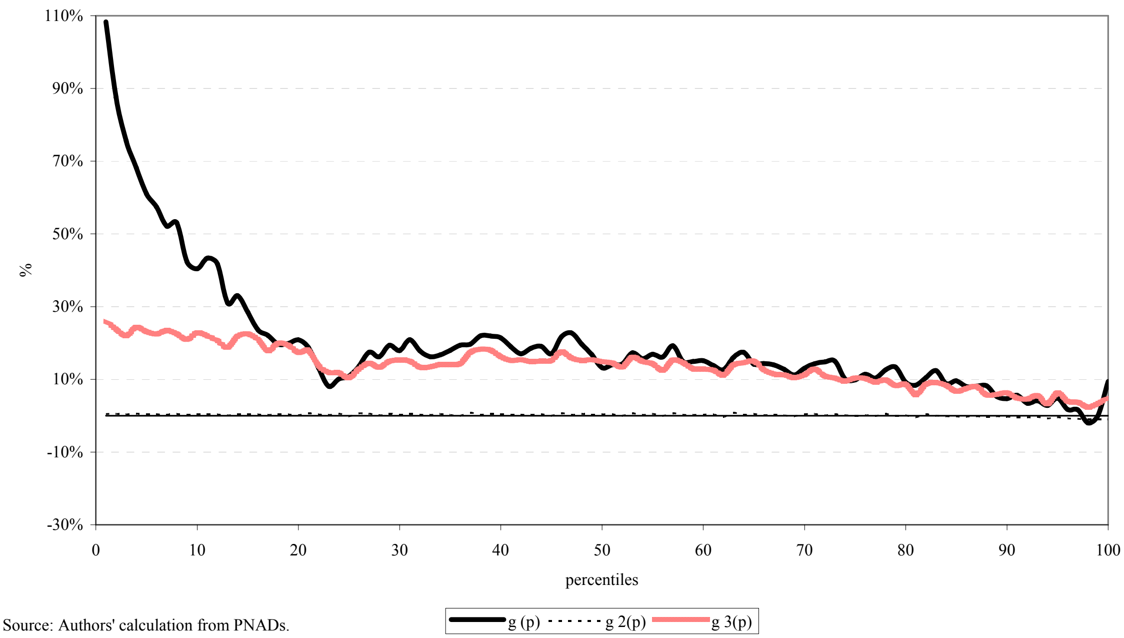
Source: Authors' calculation from PNADs.

Figure 7: Observed and counterfactual wage growth incidence curves, 1995-1988: industry and skill wage premia.



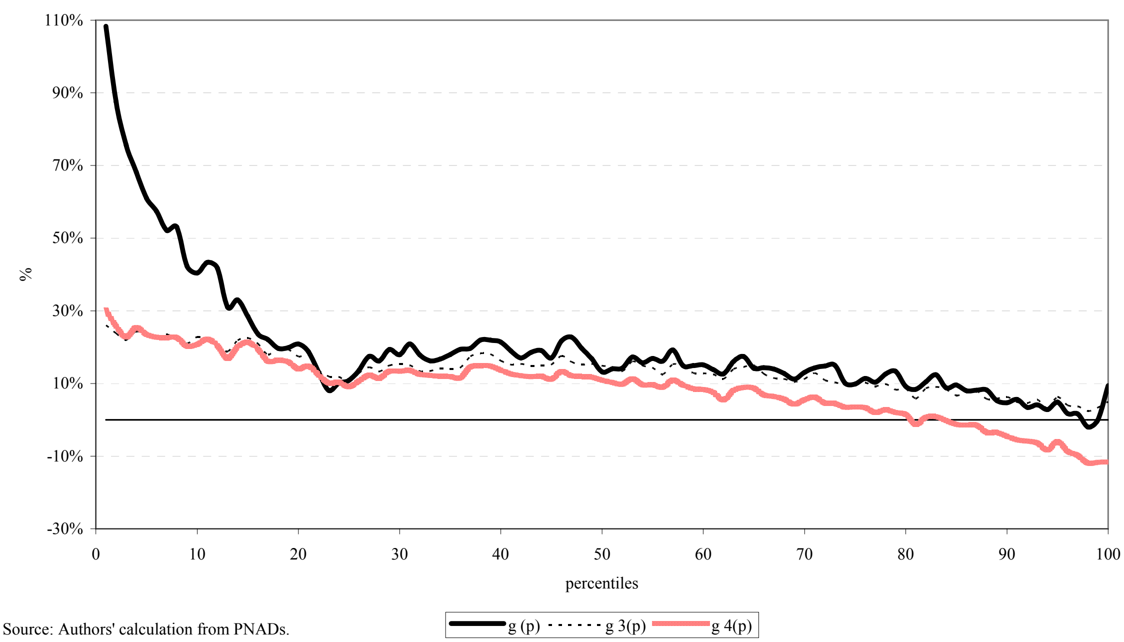
Source: Authors' calculation from PNADs.

Figure 8: Observed and counterfactual wage growth incidence curves, 1995-1988: all trade-mandated changes from 2nd stage.



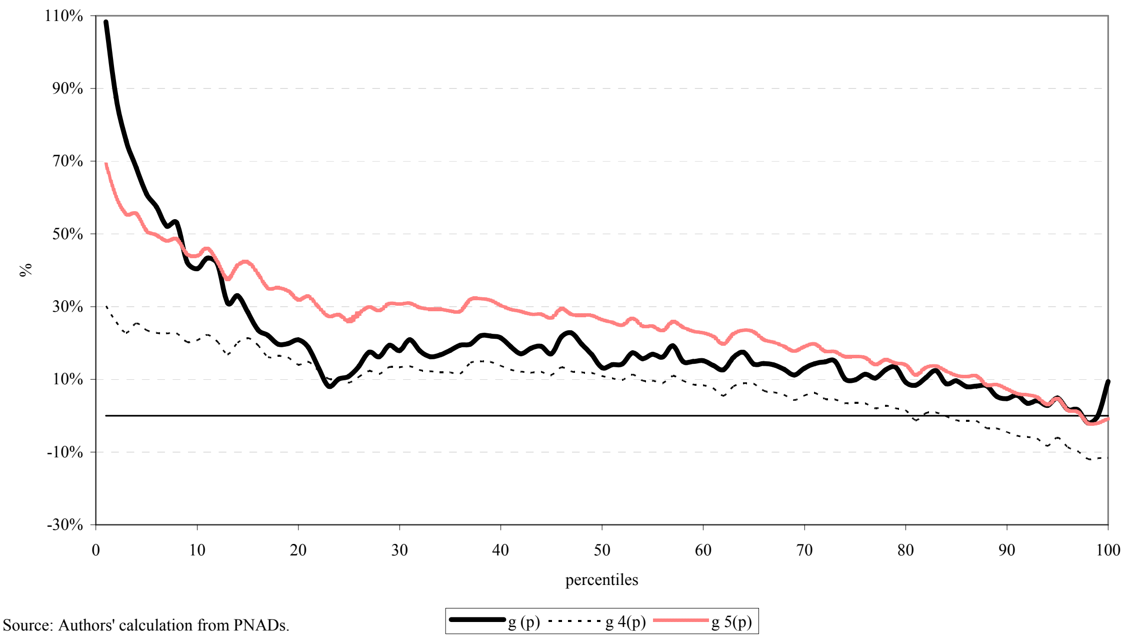
Source: Authors' calculation from PNADs.

Figure 9: Observed and counterfactual wage growth incidence curves, 1995-1988: upper-bound on trade effects.



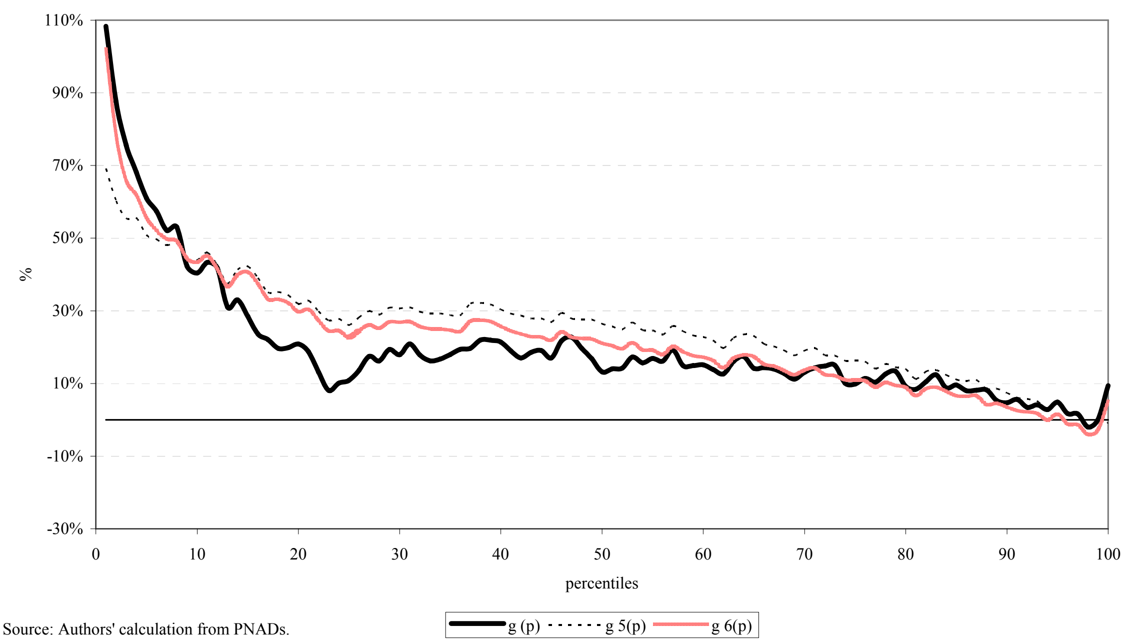
Source: Authors' calculation from PNADs.

Figure 10: Observed and counterfactual wage growth incidence curves, 1995-1988: trade effects + other price changes.



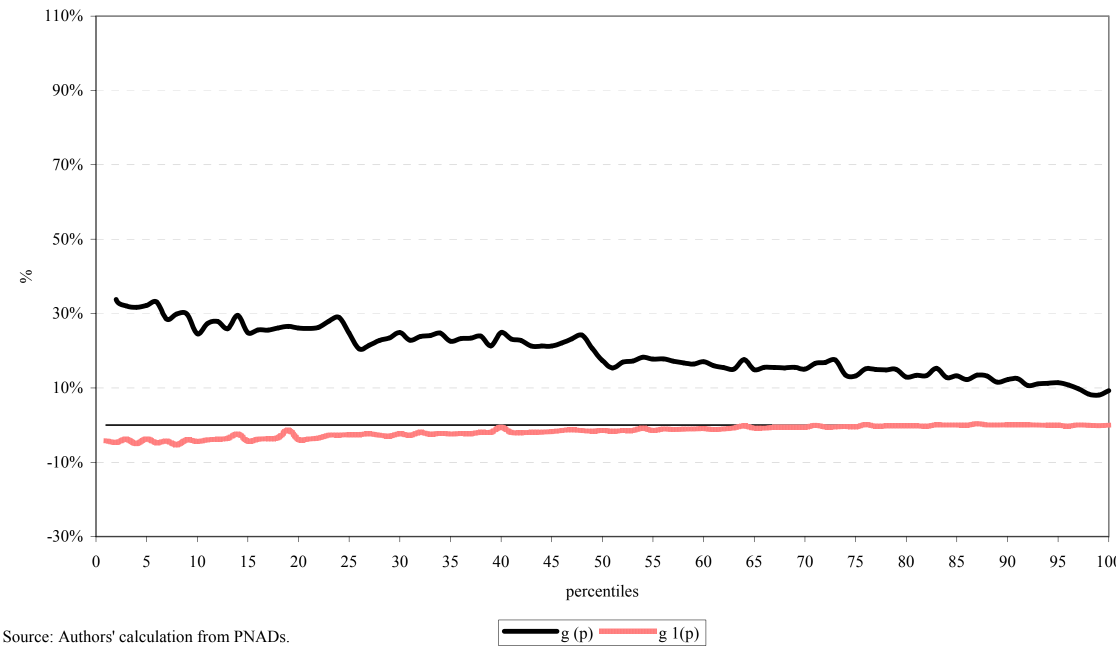
Source: Authors' calculation from PNADs.

Figure 11: Observed and counterfactual wage growth incidence curves, 1995-1988: trade effects, price changes + changes in residuals.



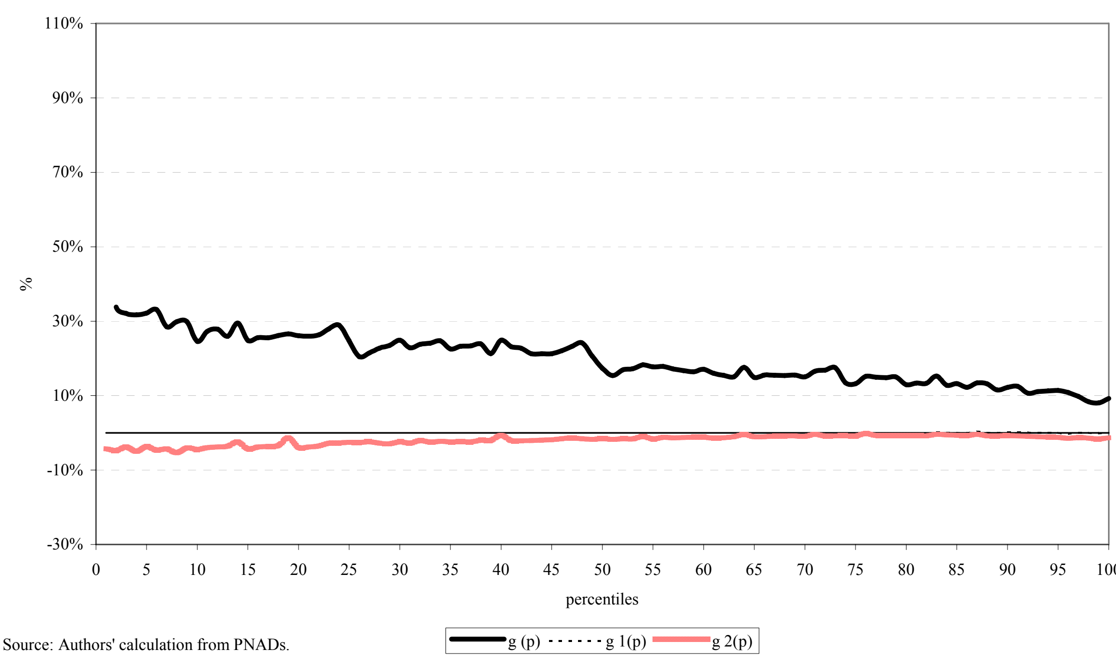
Source: Authors' calculation from PNADs.

Figure 12: Observed and counterfactual household per capita income growth incidence curves, 1995-1988: industry wage premia.



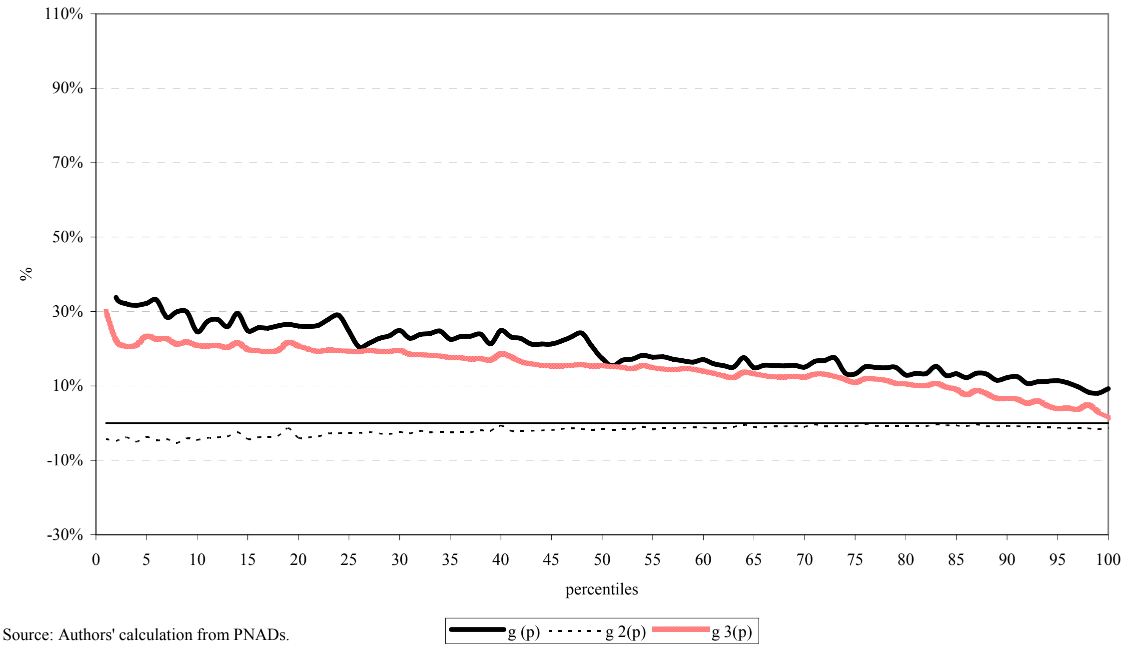
Source: Authors' calculation from PNADs.

Figure 13: Observed and counterfactual household per capita income growth incidence curves, 1995-1988: industry and skill wage premia.



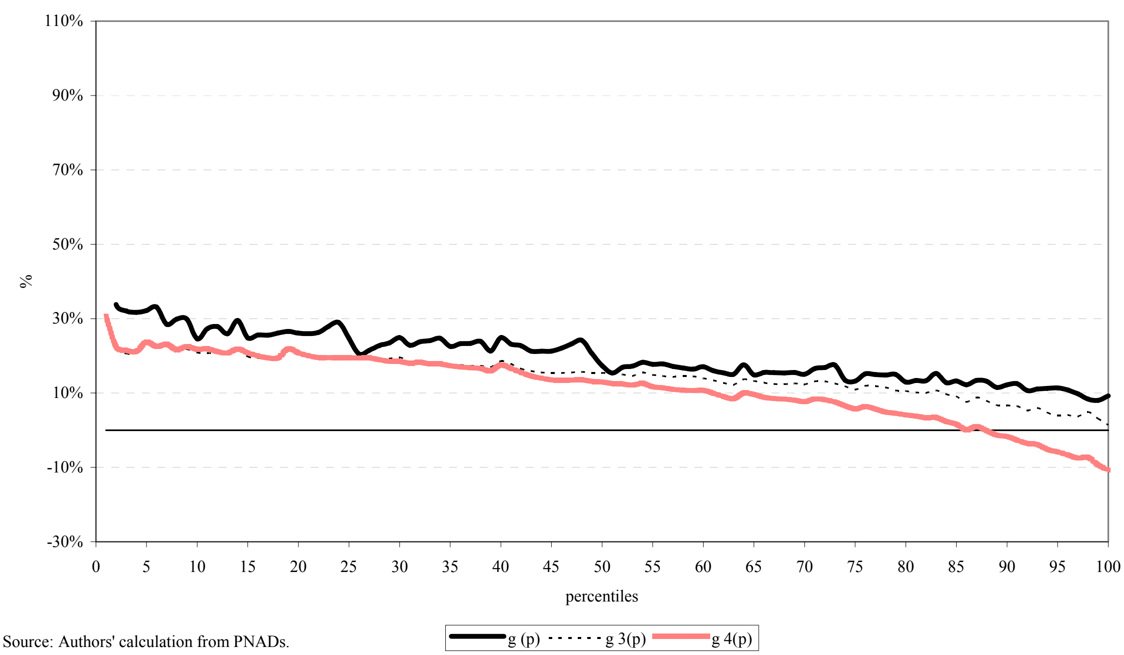
Source: Authors' calculation from PNADs.

Figure 14: Observed and counterfactual household per capita income growth incidence curves, 1995-1988: all trade-mandated changes from second stage.



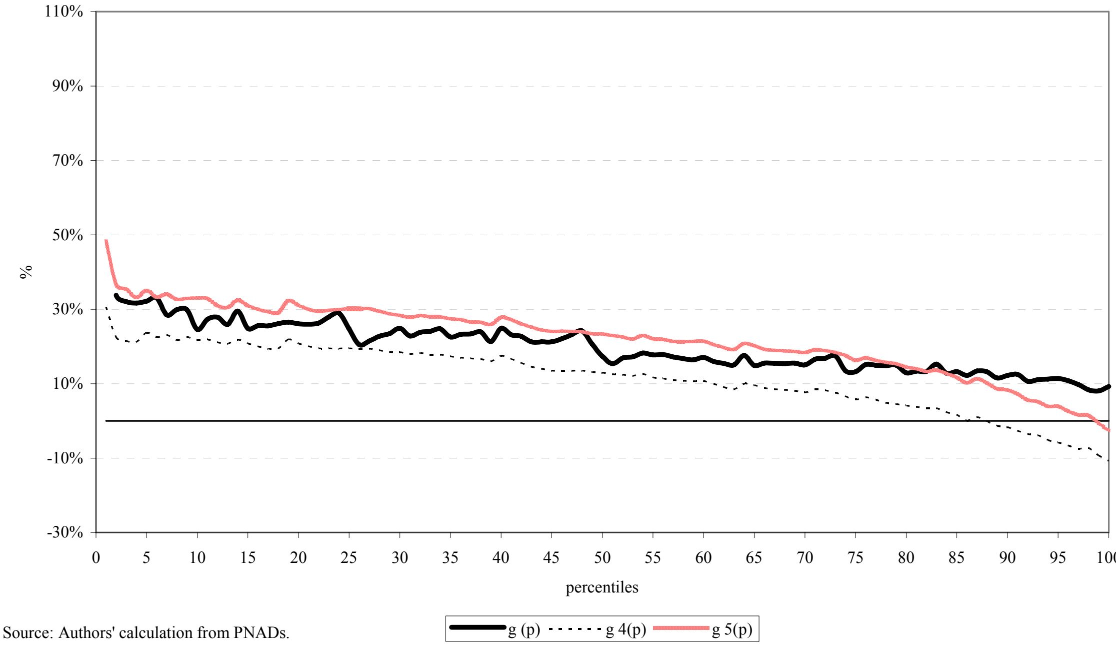
Source: Authors' calculation from PNADs.

Figure 15: Observed and counterfactual household per capita income growth incidence curves, 1995-1988: upper-bound on trade effects.



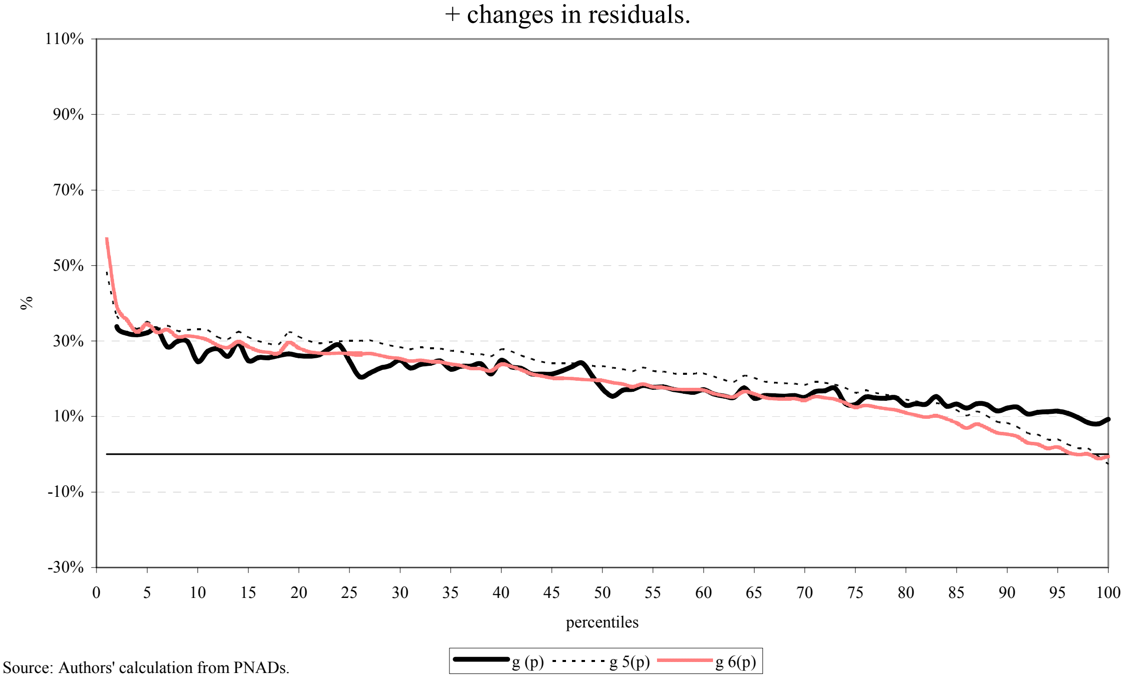
Source: Authors' calculation from PNADs.

Figure 16: Observed and counterfactual household per capita income growth incidence curves, 1995-1988: trade effects + other price changes.



Source: Authors' calculation from PNADs.

Figure 17: Observed and counterfactual household per capita income growth incidence curves, 1995-1988: trade effects, price changes + changes in residuals.



Source: Authors' calculation from PNADs.

Data Appendix

This data appendix outlines how each trade variable used in our second-stage regressions was constructed. The main trade variables are industry-specific real exchange rates; effective rates of protection; import penetration rates and export shares of production.

Industry-specific trade-weighted real exchange rates

Adapting Goldberg (2004), we construct both export- and import-weighted real exchange rates for each industry j. Goldberg suggests, respectively:

$$xer_t^j = \sum_c w_t^{jc} \times rer_t^c \text{ , where } w_t^{jc} = \frac{X_t^{jc}}{\sum_c X_t^{jc}} \text{, and}$$

$$mer_t^j = \sum_c w_t^{jc} \times rer_t^c \text{ , where } w_t^{jc} = \frac{M_t^{jc}}{\sum_c M_t^{jc}} \text{,}$$

where rer_t^c are the bilateral real exchange rates with each Brazilian trading partner c.

Rather than deriving real exchange rates for every trading partner by industry and year, a large undertaking, we have ranked countries by decreasing size of imports (exports) in each industry, and included those countries who (i) make up the first 95% of imports (exports), and (ii) whose imports (exports) are over 1% of the total within that industry. To reduce spurious volatility in the exchange rate series due to a changing composition of the set of countries in the annual weights, we depart from Goldberg by defining our weighted exchange rates with constant weights across the period:

$$xer_t^j = \sum_c w_{8599}^{jc} \times rer_t^c \text{ , where } w_{8599}^{jc} = \frac{\sum_{t=1985}^{1999} X_t^{jc}}{\sum_c \sum_{t=1985}^{1999} X_t^{jc}} \text{, and}$$

$$mer_t^j = \sum_c w_{8599}^{jc} \times rer_t^c \text{ , where } w_{8599}^{jc} = \frac{\sum_{t=1985}^{1999} M_t^{jc}}{\sum_c \sum_{t=1985}^{1999} M_t^{jc}} \text{.}$$

These weights are based on a country's share of trade over the period 1985-1999. All trading partners of significance over the period are included, and their real exchange rates are weighted identically in each year, so the variation in the aggregate industry exchange rate comes from changes in trading partners' exchange rates, rather than trade volume or inclusion/exclusion in different years.

We use trade data from COMTRADE at the SITC 4-digit level. A concordance was constructed to match each SITC2 4-digit industry code to the more aggregated industries of the ERP data from Kume et al. Imports (exports) are then summed by country over these ERP industries to give us M_t^{jc} (X_t^{jc}). Bilateral real exchange rates were constructed by multiplying each country's nominal exchange rate (in local currency per Real) by the ratio of the Brazilian price index to the partner country price index, where the WPI (wholesale price index) was used where available, and the CPI (consumer price index) otherwise. Countries for which neither a full time series of WPI or CPI were available were excluded. For the nontradables sector, we constructed economy-wide real exchange rates, using imports and exports with trading partners across all industries to derive country weights.

Effective rates of protection

ERPs from 1985-1999 are available from Kume et al. (2000). We have used them as reported in Abreu (2004). However, the industry classifications differ from those available in the PNAD. Adapting the concordance used by Pavcnik et al. (2004), we averaged ERPs across certain ERP industries using lagged industry imports as weights. The summary final concordance is reported in Table 2 in the main text.

Import penetration rate and export share of production

Both of these variables were constructed in the same way; the raw data for both is from Muendler (2003), and available at http://www.econ.ucsd.edu/muendler/html/brazil.html. These data are given by Nível 80 (an official Brazilian classification), a different industry classification than that afforded us by the PNAD, so a concordance from Nível 80 to Nível 100 (also available on Muendler's website) was used to move to Nível 100, and a second concordance from Nível 100 to the ERP industry categories was constructed by the authors to standardize industries. As with ERPs, import weights were then used to average certain industry import penetration and export share to arrive at data series for the final industries used in the paper.

Concordances

There are a number of concordances used to standardize industries across the various trade data. The final industry classifications were driven by those available in the PNAD. The concordances used were:

1. ERP industry (i.e. the industry classification used by Kume et al., which is similar to Nivel 50) to our final industry classification (author constructed).
2. ERP to PNAD (author constructed, based on Pavcnik et al. (2004)).
3. Nivel 80 to Nivel 100 (available from Muendler).
4. Nivel 100 to ERP (author constructed).
5. SITC2 to ERP (author constructed).

The steps taken to standardize each trade variable's industry classifications are listed in the table below.

Table A1: Industry Standardization: Steps and Concordances

Trade Variable	Initial Industry Classification	Concordance Steps	Concordances Used
Trade-weighted RER	SITC2	SITC2 to ERP	SITC2-ERP (authors)
		ERP to Final (PNAD)	ERP-PNAD (authors)
ERP	Unknown (referred to here as ERP)	ERP to Final (PNAD)	ERP-PNAD (authors)
Import penetration	Nivel 80	Niv 80 to Niv 100	Niv80-Niv100 (Muendler)
		Niv 100 to ERP	Niv100-ERP (authors)
		ERP to Final (PNAD)	ERP-PNAD (authors)
Export share	Nivel 80	Niv 80 to Niv 100	Niv80-Niv100 (Muendler)
		Niv 100 to ERP	Niv100-ERP (authors)
		ERP to Final (PNAD)	ERP-PNAD (authors)